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A SURGICAL DIAGNOSIS



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A SURGICAL DIAGNOSIS

BY

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Illustrated

D. APPLETON AND COMPANY
NEW YORK LONDON

1929

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PRINTED IN THE UNITED STATES OF AMERICA

To
DOCTOR ARTHUR WELLS ELTING
A GREAT SURGEON AND A LOYAL FRIEND

PREFACE

Surgical diagnosis is both an art and a science—an art in the taking of a good history and in making a thorough examination of the patient, a science in the correct application or correlation of the facts as ascertained. It is not, however, an exact science; the manifestations of a disease are often too variable, atypical cases too numerous. Be that as it may, it is safe to say that the vast majority of cases seen by student, physician or surgeon present a more or less definite symptom-complex pathognomonic of that disease. It is necessary to accurately determine the facts and then apply them to anatomic and physiologic truths. A good working knowledge of anatomy and physiology is as important in the forming of a correct surgical diagnosis as is the possession of a scalpel in properly opening the abdomen. “Snap diagnosis” is dramatic and often to the point—indeed, a keen observer and one of large experience often counts on his so-called “intuition.” Very often he is correct but as a rule it is a pernicious practice and should be deprecated; it leads too frequently to disaster. Keeness of observation and correct interpretation of facts are two imperative qualities which must be mastered by the surgeon. Gould very properly says, “We must cultivate the habit of looking behind symptoms and signs to their physical or physiological significance and not regard them as so many ultimate facts.”

The teaching of surgical diagnosis to students for a period of nearly twenty years has convinced me that it carries with it great responsibilities. The teacher must be exact in his statements—he must not quibble with his students. He should be a teacher and at the same time a member of the class which he is instructing; he must give but at times must take suggestions and always be in a receptive mood. No instructor can be successful in imparting knowledge unless his class “enters into the spirit of the game.” No teacher in surgical diagnosis can give his best unless his class thinks anatomically, physiologically and pathologically. Signs and symptoms must be visualized in conjunction with the anatomic structure in or about a suspected region. Correlation with the pathology and physiology of the particular part must follow.

In writing this work I have presented the subject in as practical a manner as possible. It is essentially a book for medical students, hospital residents and general practitioners. It is hoped that it may also prove of value to those who are teaching the subject. History taking is of such importance and value in the arrival at surgical conclusions that a considerable amount of space has been devoted in this work to the proper methods of procedure. Each important region of the body has been covered in a series of questions, each interrogation being upon some particular phase relating to the presenting symptom or region suspected of being involved. Interpretations of these questions are given in such manner as to emphasize the importance and significance of each.

A large number of regional and etiologic charts will be found. These have been formed so that the student will familiarize himself with the various pathologic

conditions which may be present when one or a group of organs or other structures of the body are suspected of being affected. A series of differential charts are also included. These are for those who have mastered the more preliminary ones. In these charts the relationship of various diseases to each other is shown and a graphic picture of their symptoms as a whole is drawn. The student is not expected to memorize these charts but experience has shown that with proper study and application he will finally visualize them in a practical manner.

The reader will note the words "generally," "under ordinary conditions," and "as a rule" throughout the book, for it must be remembered that surgical diagnosis, as before stated, is far from being an exact science.

Illustrations have purposely been omitted, except for those in the chapter on "Fractures and Dislocations" and two etiologic charts in the chapter on "Infections." The line drawings are based upon radiograms and show the methods of displacement by muscle pull and by bony deformity.

I especially desire to express my gratitude to Dr. Arthur Elting, who has been my teacher and surgical mentor throughout a number of years of intimate and personal association.

Throughout the years of labor devoted to the writing of this book, my associate, Dr. Stanley Alderson, has worked unceasingly in the compiling of subject matter and facts from hospital records and literature. For the past two years, my assistant, Dr. Emerson Kelly, has shown enthusiasm and untiring efforts in helping me as the book grew into final form. I am grateful to him.

I wish to thank Dr. Charles E. Allen who mapped out the section on Hernia.

Miss Mary Walsh, my secretary, and Mr. Ray Martin have been of great help to me in the preparation of the manuscript.

Had it not been for the help, encouragement and forbearance of my wife, I am positive that this work would not have been completed.

J. LEWIS DONHAUSER.

Albany

CONTENTS

CHAPTER	PAGE
I. CASE HISTORY TAKING	1
Questioning	2
Inspection	4
Palpation	4
Percussion	6
Auscultation	7
Laboratory Data	7
Interpretations	9
II. INFECTIONS; GANGRENE; ULCERS	13
Infections	13
Localized Infections	13
Furuncle	13
Carbuncle	14
Abscess	14
Cellulitis	14
Generalized Infections	14
Toxemia	14
Bacteriemia	15
Septicemia	15
Pyemia	15
Specific Infections	16
Anthrax	16
Erysipelas	16
Tetanus	17
Typhoid Fever	17
Pneumococcus Infections	18
Streptococcus Infections	19
Staphylococcus Infections	19
Welch's Bacillus Infections	19
Malignant Edema	20
Plague	20
Venereal Infections	20
Gonococcus Infections	20
Syphilis	21
Chancroid	22
Granulomatous Infections	22
Tuberculosis	22
Actinomycosis	23
Blastomycosis	23
Leprosy	23
Glanders	24
Parasitic Infections	24
Filariasis	24

Leishmaniasis	24
Amebiasis	24
Echinococcus Affections	24
Mycetoma	24
Nocardiosis	25
Gangrene	29
Etiology	29
Pathologic Varieties	30
Moist Gangrene	30
Dry Gangrene	30
Clinical Forms	31
Ulcers	32
History	32
Age; Sex; Occupation	32
Family History	32
Personal History	32
Physical Examination	32
Examination of Ulcer	32
Classification	33
Simple Ulcer	34
Varicose Ulcer	34
Rodent Ulcer	34
Syphilitic Ulcer	34
Trophic or Perforating Ulcer	34
Herpetic Ulcer	35
Gouty Ulcers	35
Sarcomatous Ulcer	35
Mercurial Ulcer	35
Actinomycotic Ulcer	35
Tuberculous Ulcer	35
III. TUMORS	37
Clinical Classification	37
Examination	37
Benign Tumors	38
Adenoma	38
Chondroma	38
Fibroma	38
Glioma	39
Hemangioma	39
Leiomyoma	39
Lipoma	40
Lymphangioma	40
Lymphoma	40
Myxoma	40
Myoma	40
Neuroma	40
Osteoma	41
Papilloma	41
Rhabdomyoma	41
Xanthoma	41

CHAPTER	PAGE
Malignant Tumors	41
Carcinoma	41
Chloroma	42
Endothelioma	42
Myeloma	43
Sarcoma	43
Mixed Tumors of the Salivary Glands	44
Mixed Tumors of the Testicle	45
IV. THE HEAD	46
Affections of the Scalp	46
History	46
Injuries	47
Inflammatory Conditions	48
Granulomata	49
Aneurysm	49
Nerve Manifestations	49
Tumors	50
History of Head Injury	50
Affections of the Skull	53
Malformations	53
Injuries	54
Inflammatory Conditions	54
Granulomata	55
Parasitic Cysts	55
Tumors	56
Injuries of the Brain	57
Concussion	57
Compression	57
Contusion and Laceration	62
Hemorrhage	62
Sinus Thrombosis	63
Cranial Nerve Injuries	63
Affections of the Brain and Meninges	67
Malformations and Anomalies	68
Cyclopia	69
Porencephaly	69
Cephalocele	69
Hydrocephalus	69
Hypertrophy and Atrophy	70
Injuries	70
Inflammatory Affections	70
Cerebral Abscess	71
Circulatory Affections	72
Vascular Lesions	72
Cerebral Hemorrhage	72
Cerebral Thrombosis	73
Cerebral Embolism	73
Aneurysm	73
Vascular Spasm	73
Apoplectic Seizures	74
Venous Sinus Thrombosis	74

	PAGE
Granulomata	74
Epilepsy	75
Localization of Affections	76
The Motor Area	76
The Sensory Area	76
Speech Centers	77
Writing Center	77
Vision	77
Smell and Taste Centers	77
The Frontal Lobe	77
The Parietal Lobe	78
The Occipital Lobe	78
The Temporal Lobe	78
The Basal Ganglia	78
The Corpora Quadrigemina	78
The Cerebellum	79
The Pons and Medulla	79
Tumors	79
Affections of the Face	81
Inflammations	82
Noma	82
Granulomata	82
Anthrax	84
Von Mikulicz's Disease	84
Cysts	85
Tumors	85
Affections of the Parotid Gland	91
Inflammatory Conditions	91
Granulomata	92
Tumors	93
Cysts	96
Parotid Calculus	97
Parotid Fistula	97
Affections of Stenson's Duct	97
Affections of the Lip	98
Ulcers	98
Affections of the Mouth Proper	101
Congenital Deformities	101
Inflammatory Conditions	101
Vincent's Angina	102
Fetor Oris	102
Thrush	103
Granulomata	103
Tumors	103
Affection of the Tongue	103
History	104
Congenital Abnormalities	105
Injuries	105
Inflammatory Conditions	105
Granulomata	106
Leukoplakia	106

CONTENTS

xiii

CHAPTER

PAGE

Simple Ulcerations	106
Cysts	107
Tumors	107
Affections of the Jaw	109
History	109
Infection	110
Phosphorus Necrosis	110
Granulomata	111
Tumors	111
Odontomata	114
Leontiasis	115
Hyperplasia of the Superior Maxilla	115

V. THE NECK116

Affections of the Neck	116
History	117
Acute Inflammatory Conditions	119
Chronic Inflammatory Conditions	125
Cervical Rib	126
Congenital Fistulæ	126
Aneurysm	127
Wry-Neck or Torticollis	127
Madelung's Disease	127
Esophageal Diverticulum	127
Granulomata	128
Cystic Tumors	128
Affections of Cervical Lymph Glands	130
Tumors of the Carotid Body	134
Affections of the Thyroid	134
Congenital Hypertrophy	135
Vascular Changes	135
Inflammatory Conditions	135
Granulomata	136
Goiter	137
Accessory Thyroids and Parathyroids	141
Accessory Parathyroid Cysts	141
Thyroid Bursa	142
Dermoid Cyst	142
Hydatid Cyst	142
Teratoma and Mixed Tumors	142
Hypothyroidism	143

VI. THORAX145

Injury of Thorax	145
History	145
Thoracic Wall Injuries	145
Intrathoracic Injuries	147
Affections of the Thoracic Wall	148
History	149
Inflammatory Conditions	151
Granulomata	152

	PAGE
Aneurysm	152
Pulmonary Hernia	153
Echinococcus Cyst	153
Tumors	153
Affections of the Axilla	157
History	158
Traumatic Conditions	158
Inflammatory Conditions	159
Granulomata	159
Benign Hypertrophy and Hyperplasia	161
Acute Hodgkin's Disease	162
Chronic Hodgkin's Disease	162
Acute Lymphatic Leukemia	162
Aneurysm	162
Tumors	162
Affections of the Breast	163
History	164
Inflammatory Conditions	169
Granulomata	171
Cysts	172
Hypertrophy	172
Tumors	173
Diseases of the Nipple	176
Affections of the Heart	178
Affections of the Lungs and Pleuræ	178
History	179
Foreign Bodies	182
Inflammatory Conditions	182
Granulomata	185
Pleural Cavity Affections	185
Infarct of the Lung	187
Parasitic Cyst	187
Tumors	187
Etiologic Chart of Hemoptysis	192
Affections of the Mediastinum	192
Enlargement of the Thymus Gland	193
Inflammatory Conditions	193
Granulomata	194
Retrosternal Goiter	195
Hodgkin's Disease	195
Aneurysm	195
Thoracic Duct Injury	196
Tumors	197
Affections of the Esophagus	198
History	199
Injuries	200
Inflammatory Conditions	200
Foreign Bodies	200
Ulcers	201
Strictures	201

CHAPTER	PAGE
Dilatation	202
Diverticulum	202
Spontaneous Rupture	202
Perforation	203
Spasm	203
Varix	203
Fissures	203
Tumors	203
 VII. THE MALE GENITO-URINARY TRACT	 205
Affections of the Kidney	205
History	207
General Considerations	208
Congenital Anomalies	209
Injuries	209
Inflammatory Conditions	210
Granulomata	211
Circulatory Disorders	212
Movable Kidney	213
Calculi	213
Hydronephrosis	214
Cysts	214
Parasitic Affections	215
Tumors	215
Affections of the Ureter	216
Congenital Anomalies	216
Inflammatory Conditions	216
Granuloma	216
Obstruction	217
Tumors	218
Affections of the Bladder, Prostate and Seminal Vesicles	218
History	219
Affections of Bladder	225
Congenital Anomalies	225
Atony	226
Retention	226
Vesical Fistulæ	226
Rupture	227
Calculi	227
Foreign Bodies	228
Varix	228
Hernia	228
Simple Ulcer	229
Granulomata	229
Inflammatory Conditions	230
Tumors	230
Neuroses	234
Affections of Prostate	234
Congestion	235
Inflammatory Conditions	235
Prostatorrhea	236

CHAPTER	PAGE
Calculi	236
Tuberculosis	236
Hypertrophy	237
Tumors	237
Affections of Seminal Vesicles	238
Inflammatory Conditions	238
Tuberculosis	239
Calculi	240
Affections of the Penis and the Urethra	244
History	246
Affections of the Penis	248
Congenital Anomalies	248
Injuries	248
Hypertrophy	249
Inflammatory Conditions	249
Fibrous Sclerosis	251
Calculi	251
Osseous Transformation	251
Curvature	251
Elephantiasis	251
Affections of the Skin	252
Granulomata	252
Tumors	254
Affections of the Urethra	255
Injuries	255
Stricture	257
Tumors	257
Calculi	257
Foreign Bodies	257
Granulomata	257
Fistulæ	258
Affections Causing Scrotal Enlargements	258
History	260
Acute Congestion	262
Hematoma	262
Inflammatory Conditions	262
Hydrocele	262
Varicocele	263
Elephantiasis	263
Granulomata	263
Cysts	264
Tumors	264
Hernia	264
Affections Causing Hematuria	265
Affections Causing Pain in the Back	271
History	272
VIII. THE FEMALE GENITAL ORGANS	282
Affections of the Female Genital Organs	282
Affections of the Ovaries	286
Congenital Malformations	286

	PAGE
Injuries	286
Inflammations	286
Hemorrhage	287
Pregnancy	287
Prolapse	288
Hernia or Ovariocele	289
Hydrocele	289
Granulomata	289
Solid Tumors	290
Cysts	290
Affections of the Broad Ligaments	293
Cysts	293
Parovarian Varicocele	293
Tumors	293
Tumors of Ovarian Ligaments	293
Tumors of Round Ligaments	294
Suppuration of Pelvic Connective Tissue	294
Echinococcus Disease of the Pelvis	294
Affections of the Fallopian Tubes	294
Malformations	294
Inflammations	295
Tumors	296
Tubal Pregnancy	296
Affections of the Uterus	297
Malformations	297
Injuries	297
Displacements	298
Prolapse	298
Inversion	298
Tumors	299
Inflammations	301
Hematometra	302
Subinvolution	302
Superinvolution	303
Hernia of Uterus	303
Hypertrophy of Endometrium	303
Laceration of Cervix	303
Hypertrophy of Cervix	304
Polypi of Cervix	304
Eversion of Intracervical Mucosa	305
Atresia and Stenosis of Cervix	305
Chancre of Cervix	305
Affections of the Vagina	305
Malformations	305
Cystocele	306
Rectocele	307
Hernia	307
Fistula	307
Inflammation	307
Cysts	308

Tumors	308
Hematocolpos	309
Affections of the Vulva	309
Malformations	309
Injuries	309
Inflammations	310
Tumors	310
Syphilis	310
Cysts	310
Kraurosis Vulvæ	311
Elephantiasis	311
Varicose Veins	311
Hydrocele of Labium Majus	311
Pruritus Vulvæ	311
Vaginismus	312
 IX. THE EXTREMITIES	 313
Affections of the Shoulder	324
Congenital Malformations	324
Injuries	324
Affections of Bursæ	327
Affections of Axilla	329
Affections of the Soft Parts	329
Affections of Bone	330
Affections of the Scapula	330
Affections of Joints	331
Affections of the Upper Arm	333
Congenital Malformations	333
Injuries	333
Affections of the Soft Parts	335
Affections of the Humerus	337
Affections of the Elbow Joint Proper	338
Congenital Anomalies	338
Injuries	338
Diseases	339
Affections of the Soft Tissues of Elbow	340
Injuries	340
Diseases	340
Affections of the Forearm	341
Congenital Malformations	341
Injuries	341
Affections of the Soft Parts	342
Affections of the Bones	343
Affections of Wrist Joint	343
Congenital Malformations	343
Injuries	343
Diseases	343
Affections of the Soft Tissues about Wrist	343
Injuries	343
Diseases	344
Affections of Hand and Fingers	344

CHAPTER	PAGE
Congenital Malformations	344
Acquired Deformities	345
Injuries	346
Affections of the Soft Parts of the Hand	346
Affections of the Bones of the Hand and Fingers	348
Affections of the Joints of Hand and Fingers	349
Affections of the Hip Joint	349
Congenital Malformations	349
Injuries	349
Diseases	350
Affections of the Thigh	350
Congenital Malformations	350
Injuries	351
Affections of Soft Parts	351
Affections of Femur	352
Affections of the Knee Joint Proper	352
Congenital Malformations	352
Injuries	353
Diseases	353
Affections of the Soft Tissues about Knee	354
Injuries	354
Diseases	354
Affections of the Leg	355
Congenital Malformations	355
Injuries	355
Affections of Soft Parts	356
Affections of the Tibia and Fibula	357
Affections of the Ankle Joint	357
Congenital Malformations	357
Injuries	358
Diseases	358
Affections of the Foot and Toes	358
Congenital Malformations	358
Acquired Deformities	358
Injuries	359
Affections of Soft Tissues	359
Affections of Bones	360
Affections of Joints	360
X. PERIPHERAL NERVE INJURIES	361
History	361
Determination of Sensory Disturbances	362
Types of Anesthesia in Nerve Injuries	362
Electrical Reactions	363
Brachial Plexus Paralysis	364
Suprascapular Nerve Paralysis	366
Circumflex Nerve Paralysis	366
Posterior Thoracic Nerve Paralysis	366
Musculocutaneous Nerve Paralysis	366
Musculospiral Nerve Paralysis	367
Median Nerve Paralysis	369

CHAPTER	PAGE
Ulnar Nerve Paralysis	371
Cauda Equina Paralysis	376
Great Sciatic Nerve Paralysis	377
Tibial or Internal Popliteal Nerve Paralysis	377
Peroneal or External Popliteal Nerve Paralysis	379
Anterior Crural Nerve Paralysis	381
Obturator Nerve Paralysis	382
 XI. BONES AND JOINTS	 383
Affections of Bone	383
History	385
Injuries	385
Atrophy	386
Hypertrophy	386
Inflammatory Conditions	386
Necrosis or Caries	389
Granulomata	389
Osteochondritis	391
Dystrophies	393
Diseases	393
Aneurysm	396
Exostoses	396
Osteitis Deformans	397
Cysts	397
Tumors	399
Affections of the Vertebral Column	406
Technic of Spinal Column Examination	407
Congenital and Developmental Anomalies	409
Inflammatory Conditions	409
Granulomata	410
Typhoid Spine	413
Gonorrheal Spondylitis	413
Curvatures	413
Spondylolisthesis	416
Malnutritional Diseases and So-Called Dystrophies	416
Aneurysm	416
Hysteria and Neurosis	417
Tumors	417
Affections of the Joints	418
History	419
Congenital Deformities	422
Injuries	423
Loose Bodies	423
Subluxation of Cartilages	424
Dislocations	424
Arthralgia	424
Synovitis and Arthritis	425
Lipoma Arborescens	436
Baker's Cysts	436

CHAPTER	PAGE
Tumors of Joints	436
Contractures Due to Hysteria	436
XII. FRACTURES AND DISLOCATIONS	439
Fractures	439
History	441
Fractures of the Skull	442
Fractures of the Malar Bone	447
Fractures of the Nasal Bones	448
Fractures of the Superior Maxilla	449
Fractures of the Inferior Maxilla	450
Fractures of the Hyoid Bone	452
Fractures of the Thyroid Cartilage	453
Fractures of the Vertebrae	453
Fractures of the Clavicle	459
Fractures of the Sternum	462
Fractures of the Ribs and Costal Cartilages	463
Fractures of the Scapula	464
Fractures of the Humerus	465
Fractures of the Radius and Ulna	479
Fractures of the Carpus	487
Fractures of the Metacarpal Bones	488
Fractures of the Phalanges	489
Fractures of the Pelvis	490
Fractures of the Femur	492
Fractures of the Patella	499
Fractures of the Knee and Lower Leg	500
Fractures of the Ankle	502
Fractures of the Tarsal Bones	503
Fractures of the Metatarsal Bones	504
Fractures of the Phalangeal Bones	505
Dislocations	505
Dislocations of the Lower Jaw	506
Dislocations of the Vertebrae	507
Dislocations of the Sternum	508
Dislocations of the Ribs	509
Dislocations of the Clavicle	510
Dislocations of the Shoulder	512
Dislocations of the Elbow	514
Dislocations of the Wrist	518
Dislocations of the Pelvis	520
Dislocations of the Carpometacarpal Joints	519
Dislocations of the Hip	521
Dislocations of the Knee	523
Dislocations of the Patella	524
Dislocations of the Ankle	525
Dislocations of the Toes	526
XIII. ARTERIES; VEINS; LYMPHATICS; MUSCLES; TENDONS; BURSÆ	527
Affections of the Arteries	527
Injuries	527

CHAPTER

PAGE

Inflammatory Conditions	528
Aneurysm	528
Arteriosclerosis	530
Embolism	530
Thrombosis	531
Affections of Veins	532
Injury	532
Inflammatory Conditions	532
Embolism	532
Thrombosis	532
Varicose Veins	533
Affections of the Lymphatics	533
Injuries	534
Inflammatory Conditions	534
Granulomata	535
Lymphatic Obstruction	535
Tumors	535
General Enlargement of the Lymph Glands	536
History	536
Affections of the Muscles	542
Injuries	542
Inflammatory Conditions	543
Granulomata	543
Parasitic Affections	544
Myositis Ossificans	544
Spasm	545
Atrophy	545
Hypertrophy	546
Tumors	546
Affections of Tendons	546
Injuries	547
Inflammatory Conditions	547
Granulomata	548
Ossification	548
Ganglion	549
Tumors	549
Affections of Bursæ	549
Injuries	549
Inflammatory Conditions	550
Granulomata	551
XIV. THE ABDOMEN	552
General Considerations	552
An Acute Abdominal Condition	552
History	552
XV. THE ABDOMEN (<i>Continued</i>)	567
Abdominal Injury	567
History	567
Injury of Abdominal Wall	571

CHAPTER	PAGE
Injury of Gastro-enteric Tract	572
Injury of Pancreas	572
Injury to Liver	572
Injury of Gall-Bladder	573
Injury of Spleen	573
Injury to Urinary Tract	574
Tearing of Mesentery	576
Contusion or Rupture of Diaphragm	576
Rupture of the Abdominal Aorta	576
Fractured Pelvis	576
 XVI. THE ABDOMINAL WALL, UMBILICUS AND HERNIA	 578
Affections of the Abdominal Wall	578
Injuries	578
Inflammatory Conditions	578
Granulomata	580
Cysts	580
Hernia	580
Hematomata	580
Tumors	581
Affections of the Umbilicus	581
Inflammatory Conditions	582
Concretions	582
Umbilical Fistulæ	583
Hernia	583
Gumma	583
Cysts	583
Tumors	583
Hernia	584
Etiology	585
Inguinal Hernia	586
Femoral Hernia	588
Umbilical Hernia	589
Ventral Hernia	590
Lumbar Hernia	590
Incisional Hernia	590
Obturator Hernia	591
Epigastric Hernia	591
Diaphragmatic Hernia	591
Perineal Hernia	592
Pudendal Hernia	592
Vaginal Hernia	592
Sciatic Hernia	592
Hernia Cerebri	592
Internal Hernia	593
Hernia of the Lung	593
Muscular Hernia	593
Hernia of the Testis	594
Hernia of Large Intestine	594
Clinical Varieties	594
Anatomic Varieties	596

CHAPTER		PAGE
XVII.	PERITONEUM, MESENTERY, OMENTUM AND RETROPERITONEAL LYMPH-NODES	599
	Affections of the Peritoneum	599
	Inflammatory Conditions	599
	Tuberculous Peritonitis	603
	Tumors	606
	Cysts	606
	Affections of the Mesentery	607
	Inflammatory Conditions	607
	Granulomata	607
	Hodgkin's Disease	608
	Mesenteric Thrombosis	608
	Mesenteric Cysts	608
	Tumors	608
	Etiology of Ascites	609
	Affections of the Omentum	610
	Congenital Malformations	610
	Injuries	610
	Inflammation	610
	Cysts	611
	Hernia	611
	Tumors	611
	Torsion	611
	Affections of the Retroperitoneal Lymph-Nodes	612
XVIII.	STOMACH, DUODENUM AND SMALL INTESTINE	613
	Affections of the Stomach	613
	Congenital Anomalies	614
	Cardiospasm	614
	Inflammatory Conditions	614
	Achyilia Gastrica	616
	Achlorhydria	616
	Acute Dilatation	616
	Foreign Bodies	617
	Ptosis	617
	Gastric Ulcer	618
	Perforated Gastric and Duodenal Ulcer	621
	Granulomata	621
	Tumors	622
	Hour-Glass Stomach	630
	Etiology of Hematemesis	630
	Affections of the Small Intestine	632
	Foreign Bodies	632
	Inflammatory Conditions	633
	Enteroptosis	634
	Perforating Typhoid Ulcer	634
	Granulomata	636
	Tumors	637
	Affections of the Gastro-Intestinal Tract	638

CHAPTER	PAGE
XIX. THE APPENDIX AND CECUM	640
Affections of the Appendix	640
History	640
Inflammatory Conditions	642
Granulomata	647
Cysts	647
Tumors	647
Affections of the Cecum	656
Inflammatory Conditions	656
Granulomata	656
Tumors	657
XX. LARGE INTESTINE, RECTUM AND ANUS	658
Affections of the Large Intestine	658
Congenital Malformations	659
Injuries	659
Inflammatory Conditions	659
Dysentery	660
Granulomata	661
Diverticulitis	662
Volvulus	662
Tumors	663
Affections of the Rectum and Anus	666
Malformations	668
Inflammatory Conditions	668
Anal Fistula	669
Anal Fissure	669
Granulomata	670
Hemorrhoids	671
Prolapse	671
Foreign Bodies	671
Stricture	672
Pruritus Ani	672
Diverticulum	673
Ulcerations	673
Hysteria	674
Condylomata	674
Tumors	674
XXI. INTESTINAL OBSTRUCTION	677
Acute Intestinal Obstruction	678
Mechanical Obstruction	681
Chronic Intestinal Obstruction	684
Chronic Obstruction of the Small Intestine	685
Chronic Obstruction of the Large Intestine	685
XXII. PANCREAS AND SPLEEN	687
Affections of the Pancreas	687
Inflammatory Conditions	688

Calculi	698
Granulomata	698
Cysts	698
Tumors	699
Affections of the Spleen	700
Injuries	701
Inflammatory Conditions	701
Aneurysm	703
Thrombosis and Embolism	704
Granulomata	704
Malarial Spleen	704
Rachitic Spleen	704
Wandering Spleen	704
Splénomegaly as Associated with Blood, Bone-Marrow and Liver Conditions	705
Cysts	707
Tumors	710
XXIII. LIVER; GALL-BLADDER; BILIARY DUCTS; JAUNDICE	712
Affections of the Liver	712
Examination of Liver	712
Malformations	713
Injuries	713
Infections	713
Tumors	716
Cysts	716
Chronic Passive Congestion	716
Granulomata	717
Cirrhosis	717
Aneurysm of Hepatic Artery	717
Affections of the Gall-Bladder	718
Malformations	719
Injuries	719
Inflammatory Conditions	719
Tumors	720
Calculi	720
Hydrops	721
Torsion	721
Tænia	721
Affections of the Biliary Ducts	726
Injuries	726
Congenital Anomalies	726
Inflammatory Conditions	726
Foreign Bodies	727
Parasites	728
Calculi	728
Stricture	729
Obstruction	729
Tumors	730

CONTENTS

xxvii

CHAPTER

PAGE

Jaundice	730
History	730

XXIV. THE BLOOD IN RELATION TO SURGICAL AFFECTIONS	738
--	-----

INDEX	743
-----------------	-----

ILLUSTRATIONS

FIGURE	PAGE
1. Etiologic chart of infections, neck triangles	124
2. Etiologic chart of affections, front of neck	125
3. Types of fractures	440
4. Fractures of jaw	450
5. Fracture of middle third of clavicle	460
6. Fracture of outer third of clavicle	460
7. Fracture of inner third of clavicle	461
8. Fracture of surgical neck of scapula	464
9. Fracture of the greater tuberosity of humerus	468
10. Impacted fracture of surgical neck of humerus	470
11. Non-impacted fracture of surgical neck of humerus	470
12. Fissured fracture of shaft of humerus (no displacement)	473
13. Comminuted fracture of shaft of humerus	473
14. Supracondylar fracture of humerus	475
15. Fracture of head of radius	479
16. Fracture of radius and ulna (lower third)	483
17. Colles' fracture	485
18. Colles' fracture	486
19. Fracture of finger	489
20. Fracture of pelvis (ramus)	491
21. Measurements used to determine hip measurements	493
22. Intertrochanteric fracture of femur	495
23. Fracture of upper third of shaft of femur	496
24. Subtrochanteric fracture of femur	497
25. Supracondylar fracture of femur	498
26. Fracture of the patella	499
27. Fracture of middle third of tibia and fibula	502
28. Pott's fracture	503
29. Fracture of os calcis	503
30. Shoulder contours	513
31. Backward dislocation of elbow	515
32. Backward dislocation of carpus	519
33. Backward dislocation of hip	523
34. Anterior dislocation of hip	523
35. Outward dislocation of patella	524

REGIONAL AND ANATOMIC CHARTS

	PAGE
Extremities: shoulder, shoulder joint, upper arm, elbow	313-316
Extremities: forearm, wrist, hand, fingers	316-319
Extremities: hip joint, thigh, knee	319-321
Extremities: leg, ankle, foot, toes	321-324
Nerve supply, muscles of the upper limb (anterior)	364
Nerve supply, muscles of the upper limb (posterior)	365
Nerve supply, muscles of the lower limb (anterior)	374
Nerve supply, muscles of the lower limb (posterior)	375
Acute abdominal pain, infancy and childhood	559
Acute diffuse abdominal pain	559-560
Acute abdominal pain, right upper quadrant	560-561
Acute abdominal pain, epigastric region	561
Acute abdominal pain, left upper quadrant	561-562
Acute abdominal pain, right lower quadrant	562
Acute abdominal pain, suprapubic region	562-563
Acute abdominal pain, left lower quadrant	563
Chronic abdominal pain, right upper quadrant	563-564
Chronic abdominal pain, epigastric region	564
Chronic abdominal pain, left upper quadrant	564-565
Chronic abdominal pain, right lower quadrant	565-566
Chronic abdominal pain, suprapubic region	566
Chronic abdominal pain, left lower quadrant	566

ETIOLOGIC CHARTS

	PAGE
Inflammatory conditions and infections of neck	123-125
Hemoptysis	190-191
Scrotal swellings	264-265
Hematuria	266-269
Conditions causing pain in the back, due to muscle, bone or joint de- rangement	278-281
Ascites	604-605
Hematemesis	624-629

DIFFERENTIAL CHARTS

	PAGE
Concussion, compression, contusion and middle meningeal hemorrhage	58-61
Cranial sinus thrombosis	64-65
Face	86-89
Parotid gland and Stenson's duct	94-96
Lip	99
Ulcerations of tongue	108
Cysts of the neck	130-131
Thoracic wall	154-155
Axilla	160-161
Breast	170
Breast tumors	176-177
Surgical affections of lung and pleuræ	188-190
Mediastinum	196-197
Acute abdominal pain, suprapubic region	232-233
Pain in relation to bladder, prostate and seminal vesicles	240-241
Chronic abdominal pain, suprapubic region	242-243
Lumbar pain due to kidney affections	274-277
Bone tumors	400-405
Joint swellings	434-437
General enlargement of the lymph glands	540-541
Acute diffuse abdominal pain	559
Swellings in femoral region	597
Swellings in inguinal region	598
Acute abdominal pain, epigastric region	620-621
Acute diffuse abdominal pain without shock	628-629
Chronic abdominal pain, epigastric region	628-629
Acute abdominal pain, right lower quadrant	648-653
Chronic abdominal pain, right lower quadrant	654-655
Acute abdominal pain, left lower quadrant	663
Chronic abdominal pain, left lower quadrant	664-665
Acute diffuse abdominal pain with shock	694-697
Acute abdominal pain, left upper quadrant	703
Chronic abdominal pain, left upper quadrant	708-711
Acute abdominal pain, right upper quadrant	720-721
Chronic abdominal pain, right upper quadrant	722-725
Pain in jaundice	735
Abdominal signs of jaundice	736

A SURGICAL DIAGNOSIS

A SURGICAL DIAGNOSIS

CHAPTER I

CASE HISTORY TAKING

The forming of a correct surgical diagnosis depends upon the taking of a good history, a thorough examination of the patient and the proper use of laboratory methods and instruments of precision. Upon the compilation of the facts ascertained, a correct interpretation of the case may be formulated.

Questioning
Inspection
Palpation
Percussion
Auscultation
Laboratory Data

Questioning

Conduct of examiner toward patient
Gauging types of questions asked
The subjective facts to be ascertained in the taking of a "general history"
Subjective facts referring to respiratory tract
Subjective facts referring to digestive tract
Subjective facts referring to genito-urinary tract
The forming of a "tobacco history"
The forming of a "venereal history"
The forming of an "alcoholic history"

Inspection

Facts of general importance when forming the "general record" of a case

Palpation

Methods of palpation in general
Palpation of mass or tumor

Palpation of thorax
Palpation of abdomen
Vaginal palpation
Rectal palpation
Palpation of long bones and joints

Percussion

Methods in general
Percussion of mass or tumor
Percussion of thorax
Percussion of abdomen
Percussion of long bones, vertebræ and joints
Percussion of inguinal, femoral, umbilical and scrotal swellings
Percussion of skull
Percussion of teeth

Auscultation

Auscultation of thorax
Auscultation of abdomen

Laboratory Data

Examination of urine	Examination of fluid from aspiration of swellings, including joints
Examination of stools	Examination of discharges, material from
Examination of sputum	Examination of membranous exudates
Examination of blood	X-ray
Examination of spinal fluid	Cystoscopy
Examination of fluid from thoracic aspiration	Kidney function determination
	Serum diagnosis

QUESTIONING

Conduct of Examiner toward Patient.—The taking of a good history is dependent upon the intelligence and the willingness of the patient to impart to the physician facts which might lead to the present condition and upon the manner and the tact of the physician to lend confidence to the patient. Respect, gentility and thoroughness are the requirements which above all others will help the history taker. Abruptness, browbeating and indifference as to the manner and kinds of questions asked will prove stumblingblocks to the physician. Aim to give the patient confidence. This can only be gained from experience and the ability to read human nature in its various aspects. If, on account of age, inability to speak English, or other cause, the patient cannot answer questions, a proper interpreter or relative or friend should be questioned and the history of the case ascertained in this way. Try to understand your patient's mood and temperament, and never invite a suspicion of impudence or of probing into matters not intended for the physician's knowledge.

Gauging the Types of Questions.—In the taking of a general history where no presenting symptom is to be considered, it is well to include all questions which would tend to form a "complete history."

Symptoms.—On the other hand, it is unnecessary to do so when definite presenting symptoms point to or indicate a particular part of the body or a certain tract. For instance, if a patient is suffering from a fractured toe, it is not necessary to include in the history "character of the chest wall." An attempt has been made to systematize as well as possible the most prominent symptoms found in the different lesions of the varied tracts of the body and the following questions have been so arranged as to give to the history taker various sets of questions which might be of value to him in the routine of his work.

THE MAIN SUBJECTIVE FACTS IN THE TAKING OF A "GENERAL HISTORY"

Name; Address; Age; Occupation; Nativity; Single, Married or Widow; Date of Examination

Complains of:

Family History.—Tuberculosis, cancer and other tumors, syphilis, rheumatism, heart and kidney disease, nervous conditions, diseases similar to present illness. (Ascertain, if possible, nearness of relative affected.)

Personal History.—Measles, mumps, whooping-cough, scarlet fever, diphtheria, typhoid fever, malaria, rheumatism, pneumonia, surgical operations and dates of each. Any other diseases. Exposure to the elements. Injury. Use of tobacco and alcohol.

Present Illness.—Onset, time and character. Trace course of the disease and give dates. Chills, fever, pain (radiation and character). Relation of injury or previous diseases; when compelled to give up work and when forced to go to bed. Gastric symptoms; appetite, nausea and vomiting, and character of the vomitus. Intestinal symptoms; diarrhea, constipation and character of movement. Bladder symptoms; frequency, quantity, pain and character of the urine. Cough, shortness of breath, vision, loss of weight and strength. Venereal history, menstrual history.

THE MAIN SUBJECTIVE FACTS IN CASES REFERRING TO RESPIRATORY TRACT

Cough	Fever
Dyspnea	Night-sweats
Hemoptysis	Loss of weight
Pain (location, character and radiation)	Loss of appetite
Chills	Increase in expectoration
	Appearance of sputum to patient

THE MAIN SUBJECTIVE FACTS IN CASES REFERRING TO GASTRO-ENTERIC TRACT

Nausea	Passing of stones per rectum
Vomiting (type and time)	Jaundice
Salivation	Indiscretion in diet
Pain (character, duration, time, location)	Difficulty in swallowing
Flatulence	Effect of food on pain
Eructations of gas	Alcoholic and tobacco history
Hematemesis	Shape of stools
Desire for special foodstuffs	Change in color of stools
Diarrhea	Bright red blood in stools
Constipation	Tarry stools

THE MAIN SUBJECTIVE FACTS IN CASES REFERRING TO GENITO-URINARY TRACT

Pain (character, duration, time, location)	Headache, dizziness, spots before eyes
Chills	Painful erections
Fever	Nocturnal emissions
Hematuria	Pain on defecation
Constipation	Quantity and appearance of urine
Sexual desire (increased or diminished)	Burning at end of penis before, during and after urination
Passing of calculi	Complete venereal history
Instrumentation and time	If woman, complete menstrual and marital history
Frequent urination	

THE COMPLETE TOBACCO HISTORY

Loss of appetite	Vomiting and nausea
Loss of weight	Tremors
Kind of tobacco used and manner of using	Nervousness
Headaches	Laryngeal difficulties
Palpitation	Dyspepsia
Arteriosclerosis signs	Eye affections
	Complete ophthalmoscopic examination

THE COMPLETE VENEREAL HISTORY

Presence of sore on penis or vagina and date (suspicious sore elsewhere)	Headache, especially at night
Present condition of skin	Masturbation
Presence of former eruptions	History of stricture or of recent instrumentation
Discharge from urethra or vagina	Recent debauches
Time of last intercourse	All questions should include dates

THE ALCOHOLIC HISTORY

Type of liquor used (<i>i.e.</i> , whisky, beer, wine, patent medicines containing alcohol and amount)	Hepatic congestion signs
Tremor	Nephritis signs
Vertigo	Aneurysm signs
Gastritis signs	Multiple neuritis signs
Cirrhosis of liver signs	Cardiac difficulties signs
Arteriosclerosis signs	Chronic pancreatitis signs
	Alcoholic history should be correlated with venereal history

INSPECTION

The following facts are of general importance when outlining a "general record" of a case: Nutrition of skin and muscles; build and development; decubitus; gait; expression; mental state; color of skin and mucous membranes; tremors; signs of injury (scars); position of knees; convulsions or twitchings; eruptions; signs of paralysis or paresis; pupils; swellings or tumors; ulcerations; edema; ascites; varicosities; presence of sinus; pulsations; excessive salivation; teeth; tongue (protrusion); blue line on gums; exophthalmos; kyphosis; scoliosis; opisthotonos; neck retraction; cough; hiccup; limb emaciation; deformity; type of breathing; movements of ala of nose; shape and symmetry of thorax; apex beat; abdominal symmetry; peristaltic waves; abdominal distention; hernial protrusion; enlarged regional glands; grooves (costal, iliac and clavicular); arches; condition of long bones; special description of parts involved and general measurements, if necessary; color of stools and urine.

PALPATION

Methods in General.—Palpation should be carried on in different ways, depending upon the various regions of the body to be examined. When a large extent

of tissue is to be palpated, and when a wide area, which is apparently made up of a large amount of tissue, demands palpation, the whole hand, including the palm, is to be employed. The distal half of the palmar surfaces of index, middle and third fingers are used in the palpation of masses. The little finger is rarely employed. For minute detail, the tips of the fingers will elicit more than the remainder of the entire hand.

Three methods of palpation may be employed: (1) Very light, (2) moderate, (3) deep.

Palpation elicits contour, shape, size, consistency, pulsation, extent of lesion, thrill, friction, fremitus. The hand should always be warm before palpating. Avoid rough pressure. When palpating deep-seated organs, or where there is a large amount of fat present, the other hand may be used to reinforce the examining one, by pressing down upon it.

Palpation of Mass or Tumor

Location of area involved
 Contour
 Single or multiple
 Discrete or confluent
 Movable or fixed
 Is mass adherent to skin, underlying tissue, or both?
 Is surrounding skin invaded?
 Consistency of skin over region involved
 Consistency (hard, soft, elastic, fluctuant)
 Size
 Tenderness on pressure (superficial and deep)
 Discharge on pressure
 Does mass move with respiration?
 Does mass move in swallowing?
 Increase of mass after eating
 Pulsation and thrill
 Is growth diminished on pressure?

Palpation of Thorax

Expansion
 Variations in tactile fremitus
 Subcutaneous emphysema
 Bony crepitus
 Pulsation
 Position of apex beat
 Thrill
 Palpable deformity

Palpation of Abdomen

To detect ascites
 To elicit condition of abdominal muscles (rigid, relaxed, flabby)
 To detect encysted fluid
 To detect presence of tumor or mass, with description of mass found, including range of mobility
 Sites of tenderness
 To determine condition of abdominal walls
 To determine condition of possible hernial sites
 Peristaltic waves and mounds
 Succussion wave
 Pulsation
 Thrill
 Palpation of intra-abdominal organs (see chapter on examination of intra-abdominal organs)
 Ballottement

Vaginal Palpation

Position, size and consistency of cervix
 Relation of body of uterus to cervix
 Pelvic tumor or mass (Is mass separate or does it move with uterus?)
 Sites of pelvic tenderness
 Position, size and consistency and mobility of uterus
 General condition of pelvic floor
 Vaginal tumors or growths

Vaginal Palpation (*Continued*)

Urethral tumor
 Blood stains appearing on finger after examination
 Atresia

Rectal Palpation

Stricture
 Hemorrhoids (external, internal)
 Tumor
 Rectal shelf
 Sacculation
 Sites of tenderness
 Condition of prostate and seminal vesicles

Impaction
 Palpation of pelvic viscera

Palpation of Long Bones

Exostosis
 Fracture
 Depressions
 Tibial nodes
 Mobility
 Swellings
 Tumor
 Joint crepitus
 Loose cartilage
 Areas of softening
 Sites of tenderness

PERCUSSION

Methods in General.—Four methods of percussion may be used: Light, deep, palpatory, auscultatory.

Auscultatory Percussion.—The stethoscope is used to convey the vibration of percussion sounds direct to the ear. Place chest end of stethoscope upon the surface overlying the organ to be percussed. Use finger as in ordinary percussion, beginning at a goodly distance from where the limits of the organ are supposed to be. Gradually percuss toward the end of stethoscope. When the outer border is reached a greater increase in intensity and probably some change in the character of the sound is noted.

Auscultatory Percussion of Stomach.—Place stethoscope over about seventh rib in left mamillary line. Then percuss from above downward and from side to side. When approaching border there is great clearness and intensity.

Percussion of Mass or Tumor

Dulness
 Flatness
 Tympany
 Size and extent
 Amphoric resonance

Amphoric resonance
 "Coin" sound
 Diminished or impaired resonance
 Hyperresonance

Percussion of Thorax

Abnormal dulness
 "Cracked pot" sound
 Flatness
 Tympany
 For determining outline of intrathoracic organs
 Skodaic resonance

Percussion of Abdomen

Flatness
 Tympany
 Dulness
 For determining outline of intra-abdominal organs
 Traube's semilunar space
 For eliciting deep tenderness
 For determining outline of intra-abdominal mass

Percussion of Long Bones, Vertebrae and Joints

To elicit localized tenderness (deep)

Percussion of Skull

To determine tenderness over skull, mastoid region, sinuses or branches of trigeminal nerve

Percussion of Inguinal, Femoral, Umbilical or Scrotal Swellings

To determine intestinal tympany

Percussion of Teeth

To elicit sites of pain; this is most readily accomplished with a metallic instrument

AUSCULTATION**Auscultation of Thorax**

Rate, rhythm of cardiac sounds
 Normal breath sounds
 Presence and transmission of murmurs
 Absence of breath sounds
 Increased intensity of sounds
 Decreased intensity of sounds
 Râles
 Pleuritic sounds
 Friction rub
 Vocal fremitus (whispered and spoken voice)
 "Coin" sound
 Bruit
 Bronchial breathing
 Cavernous breathing

Amphoric breathing
 Gurgling
 Metallic tinkling
 Succession sound
 Cog-wheel breathing

Auscultation of Abdomen

Swallowing sound
 Splashing sound
 Friction sound
 Borborygmi
 Bruit
 Uterine souffle
 Fetal heart sounds
 Intestinal "click"

LABORATORY DATA**Urine**

Color
 Transparency
 Quantity in twenty-four hours
 Specific gravity
 Reaction
 Albumin
 Sugar
 Diacetic acid
 Acetone
 Bile
 Occult blood
 Diazo reaction
 Bence-Jones bodies

Sediment

Amorphous and crystalline
 Epithelium, including tumor cells
 Casts { hyaline
 epithelial
 granular
 tubular
 blood-casts
 pus-casts
 Pus cells
 Red blood-cells
 Spermatozoa
 Guinea-pig inoculation

LABORATORY DATA**Urine** (*Continued*)*Bacteriology*

Tubercle bacillus
Colon bacillus
Typhoid bacillus
Ova or hooklets
Gonococcus
Streptococcus
Staphylococcus

Stools

Shape
Consistency
Odor
Reaction
Color
Biliary calculi
Enterolith
Undigested food
Undigested fat
Biliary pigments
Mucus
Mucous membrane shreds
Free blood
Occult blood
Parasites
Ova

Bacteriology

Tubercle bacillus
Typhoid bacillus
Dysentery bacillus

Sputum

Quantity
Character
Odor
Color
Mucus
Pus
Red blood-cells
Bronchial casts
Eosinophilia
Spirals

Bacteriology

Especially tubercle bacilli, pneumo-
cocci, sarcinæ
Parasites
Ova

Blood*Cultures:*

For recognition of organism in blood
stream

For recognition of Leishman's bodies

Widal:

Including typhoid and paratyphoid
reactions

Red blood-count

White blood-count

Differential count

Hemoglobin

Color index

Blood smears

For malarial parasites and filariæ

For size, shape, relative frequency and
staining reactions of red blood-cells

For size, shape, relative frequency, nu-
clear characteristics and staining re-
action of white blood-cells

For increase or decrease in blood-plate-
lets

Wassermann reaction

Gonococcus fixation test

Chemical contents:

Blood sugar

Urea and allied substances

Spinal Fluid

Color

Transparency

Reaction

Noguchi's test

Butyric acid test

Consistency

Pus cells

Free blood, or few red blood-cells

Wassermann reaction

LABORATORY DATA

Spinal Fluid (*Continued*)

Colloidal gold curve
Bacteriology for tubercle bacilli and pyogens

Fluid from Aspiration of Thorax

Color
Transparency
Reaction
Specific gravity (transudate or exudate?)
Quantity
Sediment
Slide preparations (stained)
Pleural endothelium
Red blood-cells
Pus cells
Tumor cells
Organisms, including amebæ
Ova and hooklets
Bacteriology
Guinea-pig inoculation

Fluid from Aspiration of Swellings
(Including Those of Joints)

Color
Odor
Reaction
Quantity
Consistency
Blood
Pus
Bacteriology and parasitology
Cultures
Guinea-pig inoculation

Fluid from Aspiration of Abdomen

Color
Odor
Transparency
Quantity
Reaction
Specific gravity
Red blood-cells
White blood-cells
Tumor cells
Bacteriology
Guinea-pig inoculation

Discharge Material

Bacteriology, including blastomyces

Membranous Exudates*Throat Bacteriology*

Nose
Mouth
Vagina
Urethra
Eyes
Ears

Excised Tissues

Pathology
Bacteriology

X-ray**Cystoscopy****Kidney function determination****Serum diagnosis**

INTERPRETATIONS

Age*Congenital*

Angiomata
Enlarged thymus
"Tongue-tie"

Nevi
Cholemia
Hip dislocation
Hernia
Undescended testicle
Dilatation of colon

INTERPRETATIONS

Age*Congenital (Continued)*

Syphilis
 Multiple osteomata
 Malformations
 Hemoglobinuria
 Hydrocephalus
 Pyloric stenosis
 Cystic kidney
 Optic atrophy
 Cervical rib
 Stenosis of bile-ducts
 Icterus neonatorum
 Hemorrhagic disease
 Meningocele
 Encephalocele
 Hydrocele
 Tetanus neonatorum
 Multiple lipomata
 Buhl's disease (fatty degeneration of viscera)

Infancy and Childhood

Icterus neonatorum
 Glandular fever
 Hyperplasia of lymph glands
 Intussusception
 Pyelitis
 Sarcoma of kidney
 Rickets
 Syphilis
 Whooping-cough
 Noma
 Tuberculous meningitis
 Exanthemata
 Vesical calculus
 Status lymphaticus
 Banti's disease
 Tuberculosis of bones
 Chloroma
 Hypertrophic cirrhosis
 Mumps
 Cerebrospinal meningitis
 Infantile paralysis
 Tuberculosis of lymph glands

Hydrocephalus
 Acute adenitis of neck
 Strangulation of Meckel's diverticulum
 Hernia
 Acute appendicitis
 Tuberculous peritonitis
 Pneumococcal peritonitis
 Talipes
 Adenoids
 Enlarged tonsils
 Phimosis
 Paraphimosis
 Pyloric spasm
 Pyloric stenosis
 Tuberculosis of joints
 Prolapse of rectum
 Acute gastro-enteritis
 Pneumonia
 Bronchitis
 Tuberculosis of spine
 Scoliosis

Puberty and Adolescence

Addison's disease
 Mastodynia
 Benign breast tumors

Early Adult Life

Actinomycosis
 Benign breast tumors
 Endocarditis
 Gastric and duodenal ulcer
 Acute tuberculosis
 Acute rheumatic fever
 Syphilis
 Gonorrhea
 Varicocele
 Acute yellow atrophy
 Various sarcomata
 Chlorosis

Middle Age

Aneurysm
 Apoplexy
 Addison's disease

INTERPRETATIONS

Age*Middle Age (Continued)*

Various carcinomata
 Cirrhosis of liver
 Gall-stones
 Pancreatic disease
 Pernicious anemia
 Carcinoma
 Leukemia
 Locomotor ataxia
 Tertiary syphilitic lesions
 Weil's disease
 Chronic nephritis
 Diabetes

Old Age

Various gangrenes
 Arterial derangements
 Carcinoma
 Rodent ulcer
 Osteo-arthritis
 Prostatic disease

Occupation

Anthrax
 Skin handlers
 Woolsorters
 Actinomycosis
 Farmers
 Grain handlers
 Gastric ulcer
 Domestics
 Cooks
 Cobblers
 Lead poisoning
 Painters
 Plumbers
 Lead mine workers
 Weil's disease
 Butchers
 Glanders
 Hostlers and the like
 Phosphorus poisoning
 Matchmakers and the like

Nativity

Goiter
 Certain districts of United States,
 Italy, Spain and Switzerland
 Ainhum
 East India, South America, tropics,
 Gulf states of United States
 Hepatic abscess
 Tropical regions, in general
 Dysentery
 Tropical regions, in general
 Leprosy
 Tropical regions in general; Norway
 Filaria sanguinis hominis
 Tropical regions in general; south-
 ern portions of United States

Single, Married or Widow

Refers most especially to menstrual and general uterine disturbances, each of which may be influenced by marriage. In this same connection may be mentioned the genital system so far as infection and contagion are concerned

Sex

(Not considering structural differences)

Males

Actinomycosis
 Addison's disease
 Chloroma
 Duodenal ulcer
 Gumma
 Dilatation of colon
 Pancreatitis
 Intussusception
 Congenital pyloric stenosis
 Leukemia
 Aneurysm (all varieties)
 Angioneurotic edema
 Cirrhosis (hepatic)

INTERPRETATIONS

Sex (*Continued*)*Females*

Chlorosis
 Gastric ulcer
 Anemias
 Gall-stones
 Carcinoma of gall-bladder
 Exophthalmic goiter
 Infantile pyelitis
 Trypanosomiasis
 Tuberculous peritonitis
 Rectal stricture

Acute yellow atrophy
 Floating kidney

“Hereditary Disease”

Tuberculosis
 Syphilis
 Carcinoma
 Blood diseases
 Diabetes
 Heart disease
 Bright's disease

In many instances, what the individual really inherits is not the disease itself, but a diminished power of resistance.

CHAPTER II

INFECTIONS; GANGRENE; ULCERS

INFECTIONS

Localized infections	{ furuncle carbuncle abscess cellulitis
Generalized infections	{ toxemia bacteriemia septicemia pyemia
Specific infections	{ anthrax erysipelas tetanus typhoid pneumococcus streptococcus staphylococcus Welch's bacillus malignant edema plague
Venereal infections	{ gonococcus syphilis chaneroid
Granulomatous infections	{ tuberculosis (syphilis) actinomycosis blastomycosis leprosy glanders
Parasitic infections	{ filariasis leishmaniasis amebiasis echinococcus mycetoma nocardiosis

Outside of the realm of fractures, microörganisms are, perhaps, the greatest causative agents of disease of surgical importance. They are responsible for all the infections, generalized or localized, in any part of the body.

Localized Infections

Furuncle.—This is a swelling consisting of a hard, flat or conical elevation of skin, deep red in color, clearly defined, painful and tender, on the top of

which a small pustule forms; the latter after opening discloses a greenish slough of the deeper parts of the skin and subcutaneous tissues. Often multiple and, though most frequently found on the back of the neck, widely distributed over the body.

Carbuncle consists of an ill-defined area of skin and superficial fascia which is blood red in color, brawny in consistency, very painful and tender. In the center are small vesicles, or several small apertures in the skin, exposing a soft gray slough. Carbuncles may be found anywhere on the body, but are most common on the back of the neck. The urine should be examined to determine whether there is sugar present.

Abscess is the most common of the localized infections. The staphylococcus is the causative organism in a large majority of cases. An abscess may occur in any part of the body, the organism reaching the site either from without or through the blood stream. The former is by far the most frequently encountered, abscesses of the skin, furuncles and carbuncles being of everyday occurrence. An abscess may develop in a bruised area even though there has been no open wound. Here we must hold auto-infection to have taken place, the organism coming from some form of chronic suppuration, such as the teeth, mouth, intestinal or genito-urinary tract. Organisms may remain dormant in tissues for years, and set up an inflammation when disturbed by trauma. This occurs when a part previously infected is bruised, or, in cases of typhoid osteitis, years after an acute attack of typhoid fever. Aiding the development of an abscess are a local nidus, a weakened, run-down condition of the patient or a debilitating disease. An abscess manifests itself by the general signs of inflammation—redness, heat, pain and swelling. Fever and leukocytosis may be present. When there is a breaking down of tissues, fluctuation is obtained, and the abscess “points” in the line of least resistance, usually towards the skin. When spontaneously discharged, or when incised, pus escapes from the fluctuant area.

Cellulitis.—This is a spreading inflammation, caused by microorganisms invading the subcutaneous tissue. Some type of streptococcus is usually the causative agent. The disease occurs mainly in debilitated individuals, those suffering from nephritis or diabetes being especially susceptible. The symptoms depend on the site infected. After a cut or scratch of the skin, there may be no signs for a day or two, beyond a slight inflammation and tenderness of the wound. Then, signs of a rapidly extending inflammation with high fever appear. Induration is common. Chills may be an early symptom. Toxemia is often marked. The part affected is markedly reddened, with greatest intensity along the lymphatics, which appear as red lines in the skin. Pain may be severe, with restlessness, sleeplessness and delirium. Eventually suppuration occurs and pus appears. There is great danger of a generalized infection developing. Other localized infections are known by the name of the region infected. Cellulitis in children is usually secondary to an underlying bone infection and is very rarely primary in the cellular tissue itself. See discussions of arthritis, osteitis, myositis, and others.

Generalized Infections

Toxemia is the result of the absorption of toxic material from some point of infection. The organisms themselves remain localized, but their products of metab-

olism circulate throughout the body and give rise to generalized symptoms. Toxemia and septicemia have many of the same manifestations, so that a blood culture is often necessary to differentiate them. Toxemia is recognized by fever, general malaise, increased pulse rate, dry tongue, headaches and, often, nocturnal delirium. Vomiting and diarrhea may occur. Gradually deepening coma precedes death. Symptoms may disappear rapidly or slowly after the causative infection has been effectively treated.

Bacteriemia is a term formerly loosely used to denote conditions now known as septicemia or pyemia. Strictly speaking it means organisms in the blood stream. At present the term is little used, the more exact words having replaced it.

Septicemia is an acute generalized infection caused by the invasion of the blood stream by some pyogenic organisms. Secondary abscesses do not, as a rule, develop, as in pyemia. The organisms may be in small numbers and present only at certain times, or large numbers may be found by blood culture, for several days, near the height of the infection. Organisms commonly present are, in order of frequency, streptococcus, pneumococcus, staphylococcus, *Bacillus coli* and others. These organisms gain entrance to the blood stream through any open wound, often very minute cuts and scratches. Postpartum sepsis is a common forerunner of the disease, as are otitis media, tonsillitis, mastoiditis, appendicitis, endocarditis, and other acute infections. Generally the patient is in a weakened, run-down condition, unable to resist the progress of the early infection. The symptoms of septicemia are those of an acute infection, with fever, often ranging from 104° to 105° , usually beginning with severe chills. The temperature shows slight hourly variations, but always remains high. Respirations are increased, the pulse is rapid and feeble. General malaise is present, the tongue coated and the breath foul. The skin often shows petechiæ. Diarrhea follows, and the urine contains albumin and casts. The patient grows rapidly worse, becomes delirious, then comatose, and dies. At times, a more favorable outcome follows, if the original trouble has been successfully combated, or the resistance of the patient is sufficiently great to withstand the infection. Then, after several days, or even weeks, the temperature slowly returns to normal, organisms disappear from the blood stream, and the patient enters a long period of convalescence.

Pyemia is an acute infection in which pyogenic organisms are carried through the blood stream, with the formation of multiple abscesses throughout the body. The condition may follow any acute infection, the organisms most commonly found being the streptococcus or staphylococcus, rarely the pneumococcus, gonococcus or *Bacillus typhosus*. Pyemia results only when the organisms are in such large masses or are mixed with material, such as broken down blood-clot, so that they cannot pass through the finer divisions of the arterial tree. Then, the organisms in the infected embolus develop, and an abscess results. Pyemia manifests itself in the course of an acute infection by severe chills, repeated at irregular intervals. The temperature remains high, even between the attacks of rigor, the skin is hot and flushed, and shows slight icterus, or petechiæ. The breath is foul, the excretions diminish and the patient rapidly becomes weaker. Organisms are found by blood culture. Often there is nocturnal delirium. Infected endocarditis is a frequent complication. Abscesses appear after a few days at any point in the body. Joints seem especially liable to be attacked, the pain often being less

than expected with the amount of involvement present. Extensive purulent, destructive arthritis follows, limited only by early incision. Abscesses may form in any viscus. A more chronic form of pyemia occasionally appears. The prognosis is very grave. Death is the usual result, although, if the patient's resistance is good and the organisms not too virulent, recovery may take place.

Specific Infections

Anthrax is an acute infectious disease caused by the *Bacillus anthracis*, occurring in men who work with infected cattle, either as graziers, butchers or workers in hides or wool. The three forms of the disease are cutaneous (malignant pustule), pulmonary (wool sorter's disease), and intestinal. The *malignant pustule* is found on the face, neck or arms, and begins as a red pimple, which spreads rapidly, with induration of the surrounding tissues. The center of this area turns from gray to black, is covered with vesicles containing a dark brown serum, and finally forms a slough. There is intense itching, but no pain. The lymphatic glands draining the infected area are swollen and tender. As the disease spreads the temperature rises, edema increases, vomiting occurs, the respirations grow more frequent and labored, coma sets in and death follows. The fatal outcome may be met in from two days to a week after the onset. At times the disease has a more favorable outcome, the infection limiting itself and gradually disappearing, leaving the slough to separate. *Wool sorter's disease* follows inhalation of the causative organism, or its spores. There is malaise for a few days, followed by a pneumonia with exceptionally rapid course, attended with high fever, marked dyspnea and high mortality. *Intestinal anthrax* exhibits symptoms similar to a very severe ptomain poisoning, *i.e.*, acute diarrhea, chills, nausea, vomiting and prostration; in addition there may be hemorrhages from the mucous membranes and, at times, acutely ulcerating carbuncles upon the skin, especially along the arm and about the head. The etiology of this type of the disease is generally attributed to the ingestion of meat or milk from an infected animal. One case of *gastric anthrax* has been reported (*Keen's Surgery*, Philadelphia, W. B. Saunders Co., 1910, Vol. III, p. 955).

Erysipelas is an infection of the smaller lymphatics of the skin, due to a specific type of *Streptococcus hemolyticus*. The infection usually enters through an abrasion or laceration, but the injury may have been so small as to escape notice. A weakened condition, amid unhygienic surroundings, aids in the development of the disease. After an incubation of from three to seven days, there appear symptoms as in the onset of an acute infection—rigor, rapid rise in temperature and pulse, and toxemia. A characteristic rash appears about the margin of the injured area, or, in the idiopathic variety, on the bridge of the nose and the cheek. The vivid red rash disappears on pressure, is accompanied by a sensation of burning and stiffness, and the area is covered by numerous small vesicles. There is a slightly raised margin, indicating where the infection is extending, the older areas gradually fading, with a remaining brownish stain. Regional lymph glands are swollen and painful. After seven to fourteen days the disease appears to have run its course. The rash fades, the temperature falls to normal and toxic symptoms disappear. The subcutaneous tissue is sometimes involved by an extension of the infection, the

term *cellulo-erysipelas* then being used. All symptoms are then more severe, the infected area breaks down into pus, and pyemia may follow.

A distinctive characteristic of erysipelas is that by extension the ear is involved. All subcutaneous inflammations are limited by the pinna.

Tetanus is a local infective disease, caused by the *Bacillus tetani*, and characterized by tonic spasms of the muscles. Deep penetrating wounds which have come in contact with dirt or manure are especially liable to harbor the organisms. The symptoms in the acute variety usually appear in six or seven days, with stiffness in the neck and jaws, and difficulty in mastication, often accompanied by chills. Gradually a tonic spasm supplants the stiffness, and produces trismus or lockjaw. The face is transformed by a sardonic grin—*risus sardonicus*. Downward extension follows, so that there is difficulty in swallowing, the abdominal or back muscles become involved in the tonic spasms, and positions, known as emprosthotonos and opisthotonos, are assumed. Such spasms occur in paroxysms, with great pain and perspiration. The temperature may remain normal. Death may occur as early as the third day, from heart-failure, asphyxia or exhaustion. The onset may be prolonged to from two to four weeks, and a subacute or chronic variety ensue. *Tetanus neonatorum* occurs from two to ten days after infection of the navel. It is a very fatal type, rare in this climate. Fourth of July tetanus follows wounds received from toy pistols, giant or cannon firecrackers. The onset, symptoms and course are similar to the acute variety. This form was once common, but now has become infrequent.

Typhoid Fever.—This is an acute febrile disease caused by the *Bacillus typhosus*. With it is allied paratyphoid fever, caused by the paratyphoid bacillus. It is transmitted chiefly through water and milk, less commonly through fresh vegetables, shellfish, milk products and ice. Direct contact, particularly with the discharges of afflicted patients, is also a means of transmission, while typhoid carriers constitute a third and particularly menacing source of infection. The disease occurs principally in youth and early adult life. Surgical interest in typhoid fever is twofold. First, because its manifestations may resemble surgical conditions, especially various abdominal affections, and second, because of the host of complications and sequelæ, many of which have distinctly surgical aspects.

As to the first interest, the surgeon occasionally attends a patient with abdominal pain, perhaps accompanied by nausea and vomiting, and frequently associated with distention, and intestinal disturbances, either constipation or diarrhea. The onset, symptoms and abdominal findings may simulate many of the ordinary surgical affections of the abdomen, either localized or generalized. Without detailed discussion of the variable modes of onset, and the legion of possible symptoms and signs, it may, briefly, be stated that typhoid fever is usually characterized by prodromata and certain general and special clinical phenomena. Careful history taking will often elicit preceding headache and malaise. An indifferent, lethargic mental attitude should always be suggestive; likewise, dilated pupils, heavily coated tongue and parched lips, with or without sordes. Any inconsistencies in the abdominal findings constitute grounds for suspicion. An abdomen with "doughy" feel upon palpation is significant, but by no means constant. Loss of the abdominal skin reflexes, *rose spots*, and splenic enlargement upon palpation or percussion, should be sought. High temperature, with a disproportionate pulse of low rate is a very

constant combination. Normal white blood-count, or leukopenia, in the presence of signs suggesting appendicitis, for example, should interrupt thoughts of surgical intervention. The Widal test is not of much aid in the early cases. It should be made, however, and cultures taken of the blood, urine and stools; since typhoid fever is endemic, it always merits consideration in abdominal diagnosis.

As to the second interest, a glance at the appended list of surgical complications will reveal the phases of the disease which may involve surgery. These conditions will be discussed under their regional sections.

Pneumococcus Infections.—These form a group of disease processes of vital interest, in the foreground of which stands pneumonia. Although pneumonia, for the most part, has no surgical aspects, yet the prevalence of the disease and its frequency among surgical patients establish it as a major problem in the surgeon's sphere. Like typhoid, it also constitutes a potential source of error in diagnosis, and, also like typhoid, the pneumococcus occasions truly surgical conditions, which may arise primarily, or in association with pulmonary disease. In the diagnosis of the acute abdomen, there is an ever-present preliminary decision to be made as to whether the symptoms are of thoracic or intra-abdominal origin. That pneumococcus infections of the lungs may be masked by primary abdominal symptoms is well recognized, and, since pneumonia of central origin is the chief offender in this respect, serious errors of judgment can easily be made. The only safe course is the adoption of routine chest examinations. Although there may be no positive findings in the early stages of central pneumonia, minor signs should act as warning hints. Among these are increased respiratory rate, non-interference with abdominal breathing, respiratory grunt in infants, dilatation of the *alæ nasi*, flushing of one cheek, any trace of cyanosis, occasional cough and the lateral decubitus. Rapid pulse, high or moderately high temperature and marked leukocytosis are very significant, and are to be considered presumptive evidence until pneumonia can be definitely excluded. The usual signs of consolidation indicate pneumonic infiltration, but they are not constant in the early stages. Signs of increased moisture (*râles*); any dullness, with or without accompanying changes in the breath sounds; distant, vesicular breath sounds, and alterations in vocal and tactile fremitus should be given equal consideration in such cases. We should recall the modifications of the disease in the aged, not forgetting that pneumonia may exist without rise of temperature.

Pneumonia occurs frequently in patients confined to bed for protracted periods, such as those with fractured hips, prostatic obstruction and other prolonged surgical illnesses. It is also seen as a fairly common postoperative complication. Many of these pneumonias are thrombotic in origin, but others are of an aspiration type. Pneumonia is particularly common after operations in the upper abdomen, whether performed under general or local anesthesia.

The pneumococcus may attack nearly any tissue in the body, but has predilection for the serous and endothelial surfaces. The principal surgical affections produced are empyema, lung abscess, pneumococcus peritonitis, joint infections and otitis media. Secondary meningitis is not uncommon. The exudate in pneumococcus infections is puruloplastic or serofibrinous, and is odorless. The organisms can be cultured from the blood stream in pneumonia, so that this condition is at least a bacteriemia, and many times is a true septicemia. High leukocytic count, with polymorphonuclear increase, is usually found in association with pneumococcus

infections in any locality. These infections are severe, as a rule, and give rise to considerable toxemia. In general, they are not as serious as similar infections caused by the streptococcus.

Streptococcus Infections.—The streptococcus is a frequent invader of wounds, both accidental and operative. In general, the resulting infection is more serious than that caused by the staphylococcus, since there is pronounced tendency to progression, causing lymphangitis and lymphadenitis. Toxemia, too, is more pronounced, and septicemia is not uncommon. The streptococcus is also the causative organism in many regional subcutaneous infections, such as those of the joints, bones and kidneys, and is blood borne, as a rule. The throat, tonsils, endocardium, lungs, peritoneum and meninges may also be affected.

As a cause of septicemia, the streptococcus holds the first place. This may occur, without apparent site of entry, or in conjunction with localized infections, including those of wounds. The disease is always stormy, accompanied by the usual symptoms of septic infections, and is very often fatal. Secondary abscesses in various regions are not uncommon, although most cases exhibit the features of true septicemia, rather than those of pyemia.

Staphylococcus Infections.—The staphylococcus is the cause of most of the localized infections of the skin, such as boils, carbuncles and abscesses, and likewise the majority of wounds and bone infections. It may be found in pus from any source. In respect to general infections, the staphylococcus is a producer of pyemia with the formation of multiple abscesses in various situations, especially the skeletal tissues, liver, kidneys and spleen. This is somewhat in contrast to the streptococcus which has evident predilection for serous and endothelial surfaces. Staphylococcus pyemia may be prolonged but is almost invariably fatal. The staphylococcus produces many local infections in all parts of the body. The source of entry is not always apparent.

Welch's Bacillus Infections.—Clinically, infection with this organism gives rise to gangrene, which, because of the formation of gas within the infected tissues, has earned the name of "gas gangrene." The organism is present in human feces, and in many varieties of garden and field soil, especially in fertilized ground. Although any wound may become contaminated with the Welch bacillus, infection occurs especially where muscular and fascial tissues have been traumatized, and is therefore more common in wounds accompanied by crushing injuries, in compound fractures and gunshot wounds. It is quite common in military practice, but is by no means rare in civilian injuries. Gas gangrene occurs especially after injuries to the extremities, but occasionally complicates wounds of the face, neck and trunk.

Infection gives rise to a rapidly spreading gangrene. The limb becomes swollen and shiny, sometimes tender, and painful, and putrefactive decomposition causes a foul and distinctive odor. At times, gas bubbles can be detected escaping from the wound, or can be made to appear by gentle pressure. Palpation reveals a crackling, crepitant sensation, due to the gas production in the subcutaneous fascial planes. In open wounds, exposed muscular tissue appears, grayish and soggy. Discoloration of the skin is fairly frequent, and actual gangrenous changes of the moist type may be found. The organisms can be identified on smears and cultures from the wound. Toxemia is profound in most cases. There is no infection more insidious in onset or more rapid in its course. The time from onset to death can be measured in hours,

in some instances. Sudden rise of temperature demands thorough examination of the wound and surrounding tissues. Rapid rise of pulse rate with normal or sub-normal temperature should be equally suggestive of the possibility of gas bacillus infection, and particularly so if there is any clinical expression of toxemia. Delirium is common in fairly early stages, and almost constant in late stages.

Malignant Edema.—Instances of malignant edema, an infection caused by the *Bacillus oedematis*, have been reported in man, but most of them have not been proven bacteriologically. The etiology and clinical appearance are the same as in gas bacillus infections, and the two can only be differentiated by laboratory methods.

Plague.—Infection with the *Bacillus pestis* displays three forms—the pneumonic, bubonic and septicemic varieties. Plague is endemic in some parts of the globe. It is comparatively rare in this country under present quarantine restrictions, but an occasional case appears at one of the seaports. The organism is carried by flea-infested rats and squirrels, and the latter constitute the chief potential menace in this country, particularly in California. Overwhelming epidemics of plague occurred in past centuries, perhaps the most notable of these being the “Black Death of London.”

The *pneumonic form* is characterized by rapid and severe pneumonia, with diffuse pulmonary infiltration and severe toxemia, cyanosis and splenic enlargement; the infection is rapidly fatal. In the *bubonic form*, enlarged glands, rapidly increasing in size, appear in the groins, sometimes in the axilla and other lymphatic node areas. Pneumonia is common. Suppuration may take place in the nodes. A *septicemic form* also occurs. In epidemics this may be the predominating type of the disease. It is very rapid in onset and course, and almost invariably fatal. The organisms can be obtained from the blood. Petechiae in the skin are found in any of the types of plague, and there may be hemorrhages from the body orifices.

Venereal Infections

Gonococcus Infections.—The principal gonococcus infection in the male is urethritis, and in the female, endocervicitis. It is one of the three venereal diseases, appearing three to ten days after exposure and characterized by purulent discharge, which becomes copious. In the early stages, the infection is located in the anterior urethra, but in neglected and improperly treated cases it often lodges in the deep urethra. Serious complications, some of them surgical, arise when the deep urethra has become infected. Among these are prostatitis, abscess of the prostate, peri-urethral abscess, infections of the vesicle and vas deferens, epididymitis and abscess of the testicle, cystitis and ascending infections of the urinary apparatus. Acute gonorrheal synovitis and arthritis also occur, and a very rare, but obstinate, type of spondylitis. Endocarditis may also develop. Local complications, such as balanitis and chordee, are common.

In the female, Bartholin's glands are often infected. The general tendency of the cervical infection is to ascend, particularly after a menstrual period, causing bilateral salpingitis. This, in turn, occasions many serious affections, including pyosalpinx and hydrosalpinx, pelvic peritonitis and abscess, intestinal adhesions, and, rarely, diffuse peritonitis. Gonococcus infection, with distortion and obliteration of the tubes, is the chief source of sterility in the female.

Infection of the conjunctival sac with gonococci may lead to serious ophthalmia. This occurs through lack of proper care of the discharges and the hands; by use of contaminated articles, particularly linens, and in the newborn during passage through an infected birth-canal. Gonorrheal joints are not uncommon.

Syphilis.—For complete surveys of this subject, one should consult special textbooks. The disease is usually divided into three periods, or stages. This is an arbitrary classification, as the stages really overlap, without definitive clinical markings. Syphilis is essentially a venereal disease, but “innocent” transmission takes place congenitally, and also by direct contact with open lesions, and by indirect contact, such as the use of contaminated dishes, glasses, toilet articles and linen.

The initial lesion is the *chancre*. In its typical state, this is an ulceration, first appearing within twenty-five days of exposure. It is irregularly round or oval, with sharp crater, fairly clean base and indurated edges, and is accompanied by regional adenopathy. In the male, the principal sites are the retroglandular sulcus and the prepuce, occasionally the glans penis. The shaft of the penis, the scrotum and pubic region are also selective sites. However, it may be intra-urethral. In the female, the labium and vaginal introitus are the favorite sites, but adjacent areas may be primarily infected, or the chancre may be on the vaginal wall or cervix. While the hard chancre, or ulcer, is the classical lesion, it should be recognized that a persistent papule, abrasion or fissure may be the site of primary inoculation, or, a subcutaneous, cartilage-like plaque may be the only evidence of syphilitic infection. Unless secondarily infected, the chancre of the genitalia is not painful.

An extragenital chancre may occur on any part of the cutaneous surface, or on mucous membranes, such as the mouth, pharynx and tonsils. It is well known that, in extragenital locations, a chancre may be considerably modified in appearance, and is often painful. The lip and tongue are the most frequent sites. Regional glandular enlargement is constant. Dark-field investigations should be carried out on smears from suspicious lesions in any situation. The Wassermann reaction, of course, is not usually positive during the early phase of syphilis.

The *secondary period* is, ordinarily, characterized by general symptoms and cutaneous affections. These are attributable to invasion of the blood stream by the spirochetes, but invasion really begins soon after infection. The appearance of “secondaries” occurs about six weeks to three months after infection. Symptoms, however, may be very slight or unnoticed, or may not occur. The general effects include malaise, loss of weight and appetite, sore-throat, fleeting muscular, joint and bone pains, and headache—the latter especially in the suboccipital region, and of nocturnal or early-morning type. Many other vague and apparently insignificant symptoms might be added to this list. The cutaneous manifestations include localized and generalized eruptions. These may assume various forms—macular, maculopapular, papular, miliary, etc. The lesions and their distribution may or may not be significant. Many of them are dull red or coppery in color, and leave brownish stains or whitish scars when they disappear. Itching and consequent self-inflicted lesions of the skin are common in conjunction with cutaneous syphilis.

The *third arbitrary stage* may be characterized by further cutaneous eruptions. These are usually localized, rather than widespread, and are apt to assume tuberculous, ulcerative and serpiginous types. This is, also, the stage of involvement of

various body areas or systems by the spirochetes and their toxins. Thus, the chief effects may be in the brain and spinal cord, producing symptoms of chronic meningitis, brain tumor, sclerosis, paresis, tabes, myelitis and spastic paralysis (Erb's). Or, the vascular system may be principally involved, with resulting myocarditis, endarteritis, thrombosis, apoplexy, aneurysm and chronic nephritis. Sclerotic and gummatous changes may occur in any tissues of the body, including the digestive, osseous, muscular and cutaneous systems, as well as in the brain and special glands and organs of special sense. Elaboration of these possibilities would consume an entire book.

From the standpoint of surgical diagnosis, it must be sufficient to state that syphilis may attack any or all parts of the body, and that its lesions may resemble clinically many other affections. It must, therefore, be suspected in all patients, and at all times. The Wassermann test and its more recent precipitin modifications, as applied to the blood and spinal fluid, are extremely trustworthy. A single negative reaction is not necessarily of value, however; a positive reaction cannot, of course, absolutely identify a lesion as being syphilitic. As in other fields of diagnosis, correlation of history, physical findings and laboratory results is essential. Response to specific treatment and the course of the particular condition may be the only positive means of diagnosis. Knowing the prevalence of syphilis, and its unlimited manifestations, the surgical diagnostician should bear it always in mind, especially in the presence of nodules, tumors, sinus formation, ulceration and all chronic processes; should hesitate to brand disorders as "functional" and "neurotic"; should take detailed histories and employ general examinations, and should certainly not fail to investigate the nervous system, particularly the reflex functions, in all affections of the abdomen.

Congenital syphilis may present any of the features of the acquired disease, plus stigmata which may be characteristic. These include nasal deformities, "saber" tibia, Hutchinson's teeth, inferior physical constitution and mental defects.

Chancroid.—This is a specific infection, caused by the bacillus Ducrey. It causes an ulceration of the penis or other genitalia, which is of irregular contour, sloughing and invasive, with deep crater and soft, undetermined edges. It may be very extensive, resulting in diffuse infection and phagedena. Balanoposthitis and *inguinal bubo* are common complications. The lesion is painful, sometimes extremely so.

Granulomatous Infections

Tuberculosis.—Tuberculous processes occur at all ages. The bone, joint and glandular varieties, which hold particular surgical interest, are more frequent in childhood. The etiologic factors do not require repetition here.

The signs and symptoms of the *pulmonary form* are well known. The surgeon should be familiar with the ordinary clinical modes of inception of pulmonary tuberculosis, not forgetting that gastro-intestinal symptoms are oftentimes initiatory, and that incomplete physical examinations may lead to diagnostic and therapeutic errors. He should also be familiar with the clinical course and physical findings at various stages, since surgical treatment is assuming a field of wider application.

Like syphilis, the tubercle bacillus may attack virtually all organs and tissues.

Surgically considered, the most important affections are those of the bones, joints, spinal column, the peritoneum, cervical, axillary and mesenteric glands, the fallopian tubes and solitary tubercle of the brain. Intestinal, pulmonary and splenic tuberculosis may become of surgical nature, as may tendon infections. A very important regional type of tuberculous infection involves the genito-urinary tract, affecting the kidneys, ureters, bladder and also the vesicles, vas deferens and epididymis. Chronic rectal and bone sinuses and fistulæ are often tuberculous.

For the most part, chronicity is evident in tuberculosis. Recalling the pathologic changes attendant upon this disease, we may have granulomatous and sclerosing processes, perhaps with calcification and circumscription, in one variety of lesions, and softening, caseation necrosis and abscess formation in the other variety. Access of the latter to cutaneous and mucous membrane surfaces gives rise to fistulæ and sinuses. General symptoms, such as loss of weight and strength, slight fever and malaise, may be associated. Diagnosis will depend upon chronicity and these other features. Aids to diagnosis include the von Pirquet reaction in infants, subcutaneous tuberculin test, guinea-pig inoculation of discharges, and radiography.

Syphilis is discussed under "Venereal Infections."

Actinomycosis.—This is another of the granulomata, caused by the ray-fungus and characterized by chronicity. It attacks the cutaneous surfaces most commonly, the face, neck and hands particularly, and occurs chiefly in farmers and grain handlers. Cutaneous lesions exhibit multiple nodules, which often coalesce, and which are surrounded by dense infiltration and induration, often with bluish-red discoloration of the skin. The process is attended by progressive invasion, multiple abscesses with sinus formation and grooving, or scarring, of the skin. The discharge is thin. It sometimes contains typical yellowish granules, from which the fungus may be recovered. Actinomycosis is particularly resistant to treatment. Primary actinomycosis of the lungs, the intestinal tract—especially of the cecum—the brain, kidneys, tongue, mouth and pharynx, and of the vertebral column, also occurs. In the last situation, the clinical course and special findings are identical with Pott's disease. Actinomycosis must be differentiated from syphilis, tuberculosis and the other mycotic infections.

Blastomycosis.—This is often primary in the lungs, but also occurs as a primary affection of the skin. The hands, legs and face are the favorite sites. The initial lesion is a reddened papule, which enlarges slowly, and breaks down, with ulceration and sinus formation. The discharge is a thick, or cheesy, whitish pus, from which the fungus can be recovered. The affection is chronic and resists treatment. Scar tissue deformities and contractions are common end results. A generalized form of blastomycosis, resulting in death, has also been observed. Lesions are found in the kidney, liver, bones, lungs and brain. The cutaneous affection may be associated, or there may be no external lesion.

Leprosy.—This disease, caused by the *Bacillus lepræ*, occurs in two forms, the *tuberculous* and the *anesthetic*. In the former, erythematous patches first appear on the extremities or face. Nodules then develop in the surrounding tissues. These are persistent, but the erythema fades and is replaced by brownish pigmentation. In later stages, this discoloration also disappears, leaving white, blanched patches, which may be anesthetic. In the anesthetic form, due to involvement of the nervous system, there are, first, disturbances of sensation. Later, trophic ulcerations and

peripheral necrosis of the extremities develop. Combined with anesthesia, these lesions are distinctive.

Glanders is an infectious disease, caused by the *Bacillus mallei*, occurring mainly in horses or mules, but, at times, transmitted to man. After a few days' incubation, the first symptoms appear on the hands or face, about the site of inoculation. In acute cases, the area is swollen, somewhat resembling smallpox in being covered with papules which break down into ulcers. The regional lymph glands are enlarged and tender. There are malaise, fever and pains in the bones and joints. By extension, the bones and viscera may become involved and death ensue in about a week. A chronic form is encountered, in which similar but less severe symptoms occur. In such cases, ulceration of the mucous membrane of the nose or deep abscesses are frequently found. About one-half of these cases recover. The organisms are easily found in the discharge from the primary lesion.

Parasitic Infections

Filariasis, caused by the *Filaria sanguinis hominis*, is rare in this country. It produces either a generalized infection, or swellings of various parts. The latter is known as elephantiasis, and is most common in the lower extremities. The entire limb becomes greatly swollen, gradually deformed, and may be subject to attacks of lymphangitis. The whole contour becomes changed. Warty tumors are frequent. A similar condition of the scrotum sometimes occurs. The parasites may be obtained from regional lymph-nodes and from the blood stream. In the nocturnal type, they are only free in the blood at night.

Leishmaniasis occurs in Asiatic countries, especially India. Two forms of infection are recognized in the adult. In the first, or local, form, known as *Delhi boil*, there is a firm nodule, or circumscribed ulceration, usually on one of the cutaneous surfaces. In the second, or *splenic form*, there is splenomegaly, with which are associated intermittent fever and progressive anemia. A splenic form also occurs in infants. This is found along the Mediterranean as well as in Asia, and the parasite exhibits differences, which distinguish it from the truly Asiatic form.

Amebiasis is a disease of the intestinal tract, caused by the *Amaba dysenteriae*. It is common in parts of Asia, Egypt and the Philippines, and in the southern states of this country. Dysentery, sometimes bloody, is the essential symptom. Acute and chronic forms are met with. It has surgical interest in its complications, which include hepatic abscess, lung abscess, intestinal perforation with peritonitis, and hemorrhage. The causative amebæ are found in the stools.

Echinococcus affections are not frequent in this country, being found more particularly in the Scandinavian countries and Australia. The parasite may invade the lungs, abdomen, liver, spleen, brain, genito-urinary system and the muscles. Diagnosis can be made by aspiration of the cysts. Secondary infections occur frequently. A vibratory thrill on palpation of available cysts is diagnostic, but can rarely be observed.

Mycetoma, or Madura foot, is a yeast infection, which attacks the foot. It occurs principally in India. The foot becomes swollen, multiple nodules appear in the skin and proceed to break down, with abscess formation. In later stages, the bones are also involved, and the foot becomes deformed. Peculiar granules are found

in the discharges. In some instances, these are black in color; in others, they are white, and, rarely, the granules are reddish-brown.

Nocardiosis is usually considered as a parasitic affection of the lungs. It has, however, occurred as an invader of wounds of the skin; it is very rare in this rôle.

AFFECTIONS OF SURGICAL IMPORTANCE CAUSED BY MICROÖRGANISMS

Streptococcus	{	abscess
		septicemia
		pyemia
		tonsillitis
		pharyngitis { septic sore-throat
		{ quinsy
		otitis media
		mastoiditis
		encephalitis
		Ludwig's angina
		pleurisy
		empyema
		pneumonia
		endocarditis
		pericarditis
		enteritis (phlegmonous)
		gastritis (phlegmonous)
		appendicitis
		peritonitis
		pancreatitis
		cholecystitis
		phlebitis
		osteomyelitis and periostitis
		puerperal endometritis
		rheumatic fever (?)
		erysipelas
Staphylococcus	{	abscess
		pyemia
		septicemia
		furunculosis
		carbuncle
		impetigo contagiosa
		pharyngitis
		mastoiditis
		pneumonia
		empyema
		endocarditis
		pericarditis
		cholecystitis
		appendicitis
		suppurative nephritis
		osteomyelitis
		prostatitis
		vesiculitis
		salpingitis
		osteomyelitis (long bones)
		arthritis
		synovitis

Tubercle bacillus	{	ulcers
		abscess
		generalized infection
		stomatitis
		glossitis
		meningitis
		tonsillitis
		adenitis
		laryngitis
		thyroiditis
		pulmonary involvement
		mastitis
		pericarditis
		enteritis
		proctitis
		splenitis
		tabes mesenterica
		peritonitis
Pneumococcus (Micrococcus lanceolatus)	{	arthritis
		osteomyelitis
		synovitis
		pneumonia
		empyema
		pleurisy
		sinusitis (nasal)
		otitis media
		encephalitis
		meningitis
		endocarditis
		pericarditis
Bacillus influenzae	{	peritonitis
		septicemia
		arthritis
		pharyngitis
		influenza pneumonia
Gonococcus	{	empyema
		endocarditis
		enteritis
		balanitis
		lacunar abscess
		chordee
		urethritis
		urethral strictures
		prostatitis
		cystitis
		epididymitis
		orchitis
		vesiculitis
		proctitis
		vaginitis
		endocervicitis
		salpingitis
		peritonitis
		rhinitis

Gonococcus (<i>cont.</i>)	{	stomatitis conjunctivitis (ophthalmia) myositis arthritis endocarditis septicemia
Bacillus diphtheriæ	{	diphtheria of pharynx diphtheria of larynx paralysis enteritis proctitis
Bacillus Ducrey	{	soft chancre bubo
Tetanus bacillus	{ tetanus	{ traumatic neonatorum
Anthrax bacillus	{	malignant pustule pneumonia (woolsorter's disease) intestinal carbuncles meningitis
Typhoid bacillus and para (see surgical complications of typhoid fever)	{	intestinal ulcers perforation hemorrhage cholecystitis
Bacillus coli	{	enteritis appendicitis urethritis pyelitis cystitis cholangitis cholecystitis meningitis endocarditis pyemia
Bacillus of dysentery	{	dysentery infantile diarrhea
Bacillus pyocyaneus	{	wound infection septicemia
Bacillus welchii, Bacillus aërogenes capsulatus	{	gas gangrene
Bacillus mallei	{ glanders	{ acute chronic
Bacillus lepræ	{	cutaneous leprosy anesthetic leprosy
Treponema pallidum	{	chancre ulcers tabes dorsalis cerebrospinal syphilis

Treponema pallidum (<i>cont.</i>)	{	gumma (any region)	{	brain
		endarteritis		bone
		aneurysm		liver
		general paralysis		rectum
				skin
Filaria sanguinis hominis	{	elephantiasis		
Bacillus pestis (plague)	{	septicemic		
		bubonic		
		pneumonic		
Meningococcus (Diplococcus intra-cellularis meningitidis)	{	meningitis (cerebrospinal fever)		
Comma bacillus of Koch	{	cholera asiatica		
Amebæ	{	enteritis		
		liver abscess		
		lung abscess		
Spirochæta icterohæmorrhagica	{	spirochætosis icterohæmorrhagica		
		(infectious jaundice; Weil's disease)		
Tæniæ	{	tapeworms		
		hookworms		
		trichiasis		
		pin-worms		
		echinococcus cyst		
Fungi	{	actinomycosis	{	tonsillitis
				abscess
				"hard jaw"
	{	Oïdium albicans (thrush)		
		leptothrix (tonsillitis)		
		streptothrix		
	{	blastomyces	{	blastomycosis
		Aspergillus niger (aspergillosis)		skin
				lung

TYPHOID SURGICAL CONDITIONS

Circulatory system	{	phlebitis		
		thrombosis		
		embolus		
Digestive system	{	intestines	{	atony
			hemorrhage	
			perforation	
			appendicitis	
		mesentery	(thrombosis)	
	{	liver and gall-bladder	{	abscess
			acute inflammation	
			chronic inflammation	
			cholelithiasis	
	{	peritoneum	{	peritonitis (due to perforation)
generalized or localized				

Genito-urinary system	{	bladder (atony)	
		kidney {	infarct acute pyelitis abscess
	{	male genital system	{orchitis abscess of testicle
		female genital system	{ovaritis (rare) salpingitis
Osseous system	{	osteomyelitis (especially of rib)	
		arthritis (especially of hip)	
		typhoid spine	
Pulmonary system	{	embolus	
		abscess of lung	
Parotid gland	{	acute parotitis	
		abscess	
		thyroid gland	
		acute thyroiditis	
		abscess	
Breast	{	acute mastitis (rare)	
Spleen	{	infarct	
		abscess	
Any soft tissues	{	abscess	

GANGRENE

Gangrene is a condition in which we have a local death of tissue.

Etiology

I. Direct

A. Chemical

heat
cold
inorganic
potassium hydrate
sodium hydrate
acids
organic
lysol
carbolic acid
ergot
bacterial

B. Injury to blood-vessels

mechanical
crushing
ligature
stretching
division
chemical
bacterial

II. Indirect

Vascular changes in

syphilis
alcoholism
diabetes
Raynaud's disease
ainhum
gout
nephritis
arteriosclerosis (any etiology)

Pathologic Varieties

Moist gangrene

Dry gangrene

MOIST GANGRENE

Moist gangrene may result from: Inflammation, injury, thrombosis or embolus, pressure.

Symptoms.—The prodromal symptoms depend upon the causative factor; thus, in a condition due to an *inflammatory lesion*, the affected part at first shows some swelling, accompanied by a deep, dusky, redness of the skin, shortly followed by a brown-black, green-black or black discoloration. The epithelial covering becomes loosened, blistered, and exudes a serous or bloody material, and may be easily removed from the affected portion. The muscles become dark and of a brown or purplish color, and disintegration precedes a putrid, foul-smelling “demi mass.” In the *crushing injuries* the part becomes more rapidly discolored, often assuming, shortly after the accident, a blue-red or blackened tinge. The swelling is not as pronounced as in the inflammatory type. A gangrene caused by a *sudden occlusion* of the main trunk, including the *collateral circulation*, above described, ensues. Here we have slight, or entire absence of, swelling and discoloration, with a marble whiteness of the skin and loss of pulse. The part is usually cold, and there is little effort on the part of the skin to react to pressure or pitting. Sensation is commonly impaired, and may be entirely absent. As the condition continues, the later signs of *moist gangrene* appear. The whole process may be preceded by a sharp attack of pain over some part of the affected member.

DRY GANGRENE

Dry gangrene is caused by a gradual shutting off of the circulation, due usually to arteriosclerosis, arteritis, thrombosis or embolus. The part becomes of a brown-black or black color, and, unless infection intervenes, shrivels and hardens, perhaps to a state of “mummification.” This type of gangrene represents a condition where extensive infection does not as a rule occur, though, at times, beneath the skin, areas of pus may be present. A most virulent infection may, however, accompany the condition. A line of demarcation is most pronounced in this type.

Clinical Forms

Clinical forms of gangrene are numerous and, though many of them represent the same type of gangrene, for perhaps etiological purposes the following classification should be made:

Presenile

Senile

Diabetic

Raynaud's disease

From ergot

From carbolic acid

Bed-sores

Embolic

Ainhum

Noma

Those forms occurring in pneumonia and the febrile conditions

Organs, tumors or various tissues becoming gangrenous from a twisting of a pedicle or band

GANGRENE

Form	Type	Age	Sex	Location	Pain
Presenile	Dry	Middle age Young adults	Male	Lower extremity, occasionally upper	Shooting
Senile	Dry	Old	Male	Lower extremity, occasionally upper	Sharp shooting
Diabetic	Dry	Young adult Middle age	Female	Lower extremity, occasionally upper	Sharp shooting
Raynaud's disease.	Dry	Usually young adults	Female	Fingers, toes, possibly to feet, legs, hands, arms, nose, ears	Burning pain
Ergot	Dry			Toes more often than fingers	Sharp shooting
Carbolic acid, other chemicals	Dry or moist			Any part	None
Bed-sores	Moist	Usually old		Any portion of body subjected to pressure	Usually none
Embolic	Dry			Lower extremity more frequently than upper	Very severe
Ainhum	Dry			Usually little toe. May be other toes or fingers	None at first
Noma	Moist	Young children	Female	Mouth, cheek, vulva, anus, etc.	Usually none

ULCERS

History

Age; Sex; Occupation

Family History.—Tuberculosis, syphilis and alcohol, gout, heart and liver derangements, diabetes.

Personal History.—Including above and spinal cord diseases. Date, duration and character of onset, rapidity, history of injury or wearing of tight boots. Pain.

Physical Examination.—Look for bruises or some other signs of trauma, varicosities; examination of heart, lungs, and liver. Evidence of spinal cord diseases, Signs of syphilis or tuberculosis. Urine.

Examination of Ulcer.—Location. Single or multiple; form and shape (regular, irregular, serpiginous); edges (soft or indurated, clean-cut and sharp, or irregular, steep or shallow, undetermined or shelving, ragged or “punched out”). Floor and base (degree of necrosis, nature of granulations and appearance of

GANGRENE (*Continued*)

Prodromal Symptoms	Duration	Etiology	Unilateral or Bilateral
Disturbance in sensation, muscular cramps. Cold extremity. Failing, then absent pulse	Usually long	Nodular arteritis, arteriosclerosis, possibly atheroma	Unilateral
Disturbance in sensation, muscular cramps. Cold extremity. Failing, or absent pulse	Fairly long	Arteriosclerosis; often following injury	Bilateral
Same as senile	Fairly long then spread rapidly	Nodular arteriosclerosis. Thrombosis. Diabetes.	Unilateral
Itching, tingling, perhaps local asphyxia of skin	Over long period. Frequent attacks. Congestion, then anemia	Especially in neurotics	Bilateral
Vomiting, diarrhea, intestinal colic, disturbances in sensation	Slow in development	Especially from eating rye bread	Bilateral
Tingling, numbness, then loss of sensation of part	Rapid course	Soaking of part in carbolic acid dressing	
Passive hyperemia followed by red, blue, large ulceration	Long drawn out, may spread	During protracted illness	
Cardiac symptoms. No local prodromata	Onset rapid	Embolus	Bilateral Unilateral
Slow development of fissure, then furrow, base of toe. Gradual line demarkation	Very chronic	Negro, tropics	Unilateral
Usually begins in mouth	Spreads rapidly	Often in institutions; follows debilitating illness	

secretion, smooth and glistening, indurated or non-indurated). Presence of sinus; discharge (purulent, serous, sanguineous, etc.). Condition of surrounding tissues (signs of inflammation, eczema, circumscribed infiltration, overgrowth of epidermis). Examination of discharge or pieces of tissue.

An ulcer is a circumscribed loss of tissue, accompanied by infection, and characterized by the usual formation of granulation tissue. It is usually found upon the skin or mucous membrane.

Classification

Simple
Varicose
Rodent
Syphilitic
Trophic or perforating
Herpetic

Gouty
Sarcomatous
Mercurial
Actinomycotic
Tuberculous
Carcinomatous

Simple ulcer is a loss of tissue substance, brought about by a continual irritation or trauma, and characterized by its raw surface, devoid of visible granulation; usually thickened and fairly soft with sharp edges; an indurated base, the floor of which is clean and red, and exuding a thin serous material. It is usually *painful*. As the process becomes chronic, the edges and base become indurated. Under this type should be included the "decubital ulcer" of the tongue.

Varicose ulcer is found in connection with the presence of varicose veins of the leg, the most common site being the lower third, though any part of the leg may be involved in the process. For causes of varicose veins, see "Varicose Veins." It is a condition found most especially in women past middle life, though young, as well as old men are often afflicted. The diagnosis, as a rule, is not difficult. The chief characteristics to be considered are: The possible presence of varicosities connected with, or in the neighborhood of, an ulceration; an often deeply pigmented, brownish, coppery or bluish, thickened and indurated skin about the ulcer, which in turn may be irregular in outline, with fairly indurated edges, and a thickened base, verging upon a normal tissue. The floor is often of a dirty red-yellow, and exudes a serosanguineous material. The skin about the ulcer is often covered with eczematous crusts, and, extending over the neighboring tissues, may be a lymphangitic or an erysipelatous rash. The healing process, as a rule, is slow and tedious, and may extend over a very long period of time. The condition may accompany a tuberculous or syphilitic lesion, and, as complications, we may have extending infection, gradually causing bone necrosis and malignant degeneration. The inguinal glands are rarely affected, unless we have extending infection or malignancy; even in these two latter conditions the glands may show no involvement. It should be noted that the condition may follow a most trivial injury, which may be the starting point of the ulceration. Generally, pain is not present, though it may be quite acute and severe.

Rodent Ulcer.—See "Epithelioma."

Syphilitic Ulcer.—This is most commonly found on the penis and tongue, for which see "Affections of Penis" and "Affections of Tongue."

Trophic or Perforating Ulcer.—The etiology of this type of ulcer is variable, and a large number of causes have been assigned to it. In summing up, however, it is quite safe to say that there are three main groups of diseases which should be considered when making a diagnosis of a trophic or penetrating ulcer; namely, affections of the spinal cord, affections of the peripheral nerves, and diabetes mellitus. At times, we should bear in mind the possibility, as an etiologic factor, of a nerve or vascular lesion, and whether there is direct or indirect pressure or a definite vascular disease. The most common conditions are tabes, syringomyelia, fracture of the spinal column with cord injury, spina bifida, progressive muscular atrophy, peripheral neuritis, injury of a peripheral nerve, syphilis, arteriosclerosis, leprosy and diabetes. It is essentially an ulceration of the sole of the foot, though it may, very rarely, be found in other parts of the body, such as the hand. It is most frequently found where pressure and irritation are greatest; namely, on the sole of the foot, at the junction of the great or little toe with the metatarsal bones, directly in the "ball of the foot"; the plantar surface of the great toe; the heel; and the lateral aspects of the metatarsus. The process is primarily characterized by an extensive epithelial proliferation, which may resemble a callus or corn; after a variable length of time, perhaps weeks or months, a slight superficial ulceration

appears in the center of the thickened tissue and there soon follows a slight discharge of a thin, purulent material, offensive in character. The indolence of the condition is marked, and there gradually appears a shelf of thickened epithelium. The edges are usually clean cut, hard and indurated, the floor is of a bluish tint, covered with a watery pus, and the base shows signs of an extreme callosity. As the condition slowly advances, the ulceration may spread deeply into the surrounding tissues, or may show a tendency toward burrowing vertically into the underlying tissues, at times penetrating the bone. Pain is usually absent, and there is little or no tendency to respond to treatment.

Herpetic ulcer is secondary to herpes, and is most commonly found in the corners of the mouth, the vermillion borders of the lips, and the tip, dorsum and lateral aspects of the tongue. It is more or less contagious, but usually assumes a most benign state of ulceration, responding well and quickly to treatment. It is most commonly found in "dyspeptics." It is characterized by a painful, red, regular, usually multiple ulceration, with soft and straight edges, a shallow, more or less punched-out crater, the floor of which is usually covered with a gray slough; its base is composed of soft granulations.

Gouty Ulcers.—This is not a very common condition, but occasionally occurs in a person with gout, appearing over the site of a gouty deposit, especially over the metatarsophalangeal articulation of the great toe. It is diagnosed by its small, shallow and smooth appearance, at times painful, and discharging a white, watery fluid, which leaves a white-gray deposit on the surrounding skin.

Sarcomatous Ulcer.—This has no special characteristic features. Its appearance, its contour and its other diagnostic signs will vary with the structure of the tumor found. Perhaps the most constant signs are its irregularity, its tendency toward fairly rapid progress, and the tumor infiltration about its base and surrounding skin. A dirty, sanguineous, purulent exudate, with intermittent hemorrhages, occurs frequently. Lymph-gland enlargement is usually present.

Mercurial ulcer occasionally occurs in those who have been ptyalized, or who have no tolerance for mercury. It appears as a painless (very uncommonly, painful), whitish and irregular ulceration with soft and jagged edges, and a shallow and more or less irregular crater, the floor of which is covered with a red-white slough. The base is soft, and presents no induration. The tongue is the site of preselection for these ulcerations, and they may be found on any portion of it.

Actinomycotic Ulcer.—These ulcerations may be found in any part of the body, but most frequently appear on the lower jaw, cheeks, neck and tongue. When occurring on a skin surface, they present as multiple, irregular, gray-yellow ulcers, with irregular and fairly indurated edges and base, surrounded by a nodular and markedly thickened skin. The floor is covered with a dirty yellow film, which exudes a yellow-gray exudate, in which may be found the ray-fungi of actinomycosis. It is usually painless, and not attended with glandular involvement. There are found multiple sinuses, often extending toward the deeper tissues and underlying skin.

Tuberculous Ulcer.—This type of ulcer is found most commonly on the tongue, for which see "Affections of the Tongue." It may appear in other parts of the body, especially at the site of a breaking-down tuberculous lymph gland. It is characterized in these regions (excluding tongue) as an indolent sore, presenting as its

characteristics, an uneven, more or less irregular floor, covered with a dirty yellow, perhaps caseous material, surrounded by often undermined, soft, pink or livid, granulatory edges, with a neighboring jagged skin of a pale blue. From it is discharged a yellow, thick material. Its non-indurated character is to be noted.

See Differential Chart, "Ulcers of the Tongue."

CHAPTER III

TUMORS

CLINICAL CLASSIFICATION

<i>Benign</i>	<i>Malignant</i>
Adenoma	Carcinoma
Chondroma	Chloroma
Fibroma	Endothelioma
Glioma (often malignant)	Lymphoma (atypical)
Hemangioma	Lymphadenoma
Leiomyoma	Lymphosarcoma
Lipoma	Myeloma
Lymphangioma	Sarcoma
Lymphoma (typical)	Mixed tumors of salivary glands and testicle
Myoma	
Myxoma	
Neuroma	
Osteoma	
Papilloma	
Rhabdomyoma	
Xanthoma	

This topic will be discussed from the standpoint of *true tumors* and will review in a general way those which are of clinical value and which in Mallory's definition of a true tumor are new formations "of cells which proliferate continuously and without control; tend to differentiate as the cells from which they arise would do under normal conditions; serve no useful function; lack an orderly structural arrangement and have, at least at the present time, no assignable cause for their existence."

In this chapter we shall speak clinically of tumors as being divided into the *benign* and *malignant* forms, considering the former as being of slower growth, encapsulated and with no tendency toward metastasis; the latter as being of rapid growth, usually not encapsulated and with a tendency toward infiltration of the surrounding tissues and metastasis. The *mixed* tumor is considered as being of a benign or malignant nature. It must be remembered, however, that at times one or more of the requisites of a malignant tumor may be absent. A benign tumor may at any time become malignant, while a malignant tumor may rest dormant for a long while. The foregoing chart is a classification of the benign and malignant tumors, clinically considered under the above definitions. No attempt will here be made to differentiate according to structural or etiologic derivation.

Examination.—The following points should always be noted in examining a tumor:

Location	Tenderness on pressure—superficial and deep
Contour and color	Discharge on pressure
Single or multiple	Pulsation
Discrete or confluent	Diminution of growth on pressure
Movable or fixed	Invasion or infiltration of surrounding skin
Adherence to the skin, underlying tissues or both	Evidences of metastasis
Consistency of skin over region involved	Rate of growth
Consistency of tumor; hard, soft, elastic or confluent	Appearance of metastasis
Size	Regional lymph-gland involvement

BENIGN TUMORS

Adenoma is a benign tumor of glandular origin occurring throughout the body wherever there is glandular tissue. It may project above the surface of the involved organ, be imbedded in its substance or contain such dilated spaces as to form cysts. It is usually single, but may be multiple; it is slow-growing, encapsulated, and does not metastasize or recur after complete removal.

In the intestinal tract, adenomata are very common. They are often multiple and may be pedunculated on a long stalk which adds to the exposure of constant irritation. Frequently they give rise to obstruction or may start an intussusception. They occur in the mammary gland where the abundant stroma has given rise to the term *adenofibromata*. Here the formation of cysts is very common. In the thyroid gland adenomata with cystic formation are frequent. In the ovary, *cystadenomata* are unilateral or bilateral, simple or multilocular, usually small, but may be so large as to distend the whole abdomen. The kidney, liver and prostate are also favorite sites for these benign growths.

Chondroma is a tumor made up of cartilage. It is characterized by its slow growth, extreme hardness and a usual fixity to the underlying tissues. Commonly, it is irregular and knobby, occasionally smooth. The peculiar pearly translucency of cartilage is quite characteristic on cross section. Its size varies, at times growing to considerable proportions. Chondromata are most commonly found in childhood and early adult life, though no age is exempt. Occasionally it is multiple and at times congenital. The most common sites of occurrence are the *epiphyseal junctions of the long bones*. When a tumor of this type grows rapidly, sarcomatous degeneration must be seriously considered.

Fibroma is a tumor of connective-tissue origin, most commonly arising from the skin, fascia, periosteum and the connective tissue of the breast, bladder and the viscera; indeed, no part of the body where there are connective-tissue elements is immune. Clinically two main varieties are recognized; namely, *fibroma durum*, or hard fibroma, and the *fibroma molle*, or soft fibroma.

Various subdivisions of the fibromata are made, depending upon their contour, their locality or their association with other histologic structures. Among the most common is the *tuberous fibroma*, which, though presenting the usual characteristics of the fibroma, is of a lobulated or knobby form; the *papillary fibroma*, which presents as a branching, irregular tumor most commonly emanating from the skin,

pelvis or the kidney and bladder; the *keloid*, which appears in the skin as a rounded or clawlike, smooth or slightly irregular growth, or as a very prominent, hard and hypertrophied scar occurring after burns or wounds, and especially found in the negro. It at times is known to have occurred spontaneously. The *fibroma molluscum*, or multiple fibroma, occurs in large numbers, along the course of nerves, especially about the terminal nerves of the skin (von Recklinghausen's disease).

The main characteristics of all fibromata are the slowness of growth, the free mobility and density of the tumors, their encapsulation, and usually the regularity of the masses.

Fibromata in the wall of a viscus have a tendency toward projecting into the cavity in a pedunculated fashion, and under these conditions the mass is known as a *polyp*. Sarcomatous degeneration of a fibroid is rare—myxomatous degeneration is common.

Glioma.—Tumors of glial cells and fibrils are found only in the central nervous system and its derivatives, most especially in the brain. Clinically they may only be diagnosed by the pain or nervous symptoms which the patient presents. The severity of the symptoms depends upon the site and the extent of the tumor. These tumors are essentially benign, though from their location and from their occasional tendency to become malignant, they very often prove fatal. Injury is apparently often a predisposing factor. They may have a dense fibromatous hardness or the softness of the most cellular sarcoma. Their size may vary considerably, as may also their color, which varies from a pearly white to a reddish gray; they are usually spherical in the brain, rod shaped in the cord.

Hemangioma is usually of congenital origin. It most commonly occurs in the skin and subcutaneous tissue but is found in the spleen, bone-marrow, liver and brain; the latter situation being of little surgical import. These tumors may be level with the surface or may appear as nodular masses, as a rule covered with normal skin. They may be small or very extensive and their color varies from a normal appearing skin to a pigmented form, that of a light pink to a deep purple. Hemangiomas are soft and compressible, with often a fixity to the overlying skin.

Leiomyoma.—This is essentially a smooth muscle tumor. It grows in any situation where smooth muscle is found, though from a surgical point of view the uterus and alimentary tract present the most common and the most important regions causing surgical interference. The uterus is the most common site for the appearance of the leiomyoma, these tumors commonly being called "fibroids." The leiomyoma of the uterus is always associated with an overgrowth of connective tissue within the tumor, the term *myofibroma* being used when there is a superabundance of myomatous tissue; the term *fibromyoma* when there is an even growth of fibrous tissue. They are slow growing, tough, hard, regular masses, well encapsulated, usually multiple, originating in the uterine wall. Their location is, within the wall itself (the so-called *intramural* type), beneath the serosa (the so-called *subserous* type) and beneath and projecting into the uterine canal (the *submucous* type). They at times grow to enormous proportions, although the advent of abdominal surgery has caused marked diminution in the frequency of this size. On cross section the appearance is one of extreme density, with scattered, pearly white "whorl-like" masses, varying in number with the amount of fibrous tissue

present. Degenerative changes, especially of the hyaline and myxomatous type, are of frequent occurrence. Sarcomatous change is occasionally present. The so-called *adenomyoma* of the uterus is usually situated in the posterior uterine wall and is distinguished by its histologic appearance. The extra-uterine type of adenomyoma is being recognized frequently. Leiomyoma or adenomyoma of the alimentary tract, especially of the small intestine, is of surgical importance due to the possibility of mechanical obstruction of the gut lumen. It is usually of the pedunculated variety.

Lipoma, or fatty tumor, is a slow growing, usually freely movable, lobulated and elastic growth, varying in size from one of extreme smallness to one of such tremendous proportions as to become dangerous to life from pressure. It most commonly arises from the subcutaneous, subserous and muscular tissue, but may be found in any part of the body, even where there is no fat present, such as in the brain. Large lipomata are common on the back, shoulders and neck. Rarely there is found a diffuse lipoma of the neck, termed *Madelung's fat neck*. *Multiple lipomatosis* is not extremely uncommon.

Lymphangioma.—A variable number of pathologic subdivisions are given to this tumor, but from a practical surgical standpoint we may consider them as rare, slow-growing tumors, arising from the lymph endothelium, giving rise to small (often very large) cystic masses in the subcutaneous tissue. A correct clinical diagnosis is rarely possible.

Lymphoma.—*Typical*.—The term lymphoma is used to describe any benign, circumscribed hypertrophy of the lymph-nodes. These enlargements are local or general and slowly progressive without signs of malignancy. They may persist for several years in the neck, axilla, groin or other regions and in many cases are thought to be due to chronic infections, particularly tuberculosis. Their chief importance is in differentiating them from malignant tumors of lymphatic tissue, the lymphadenoma or lymphosarcoma or from leukemic conditions.

Myoma.—Clinically similar to myofibroma.

Myxoma.—This type of tumor must be considered as a definite clinical entity, though it is extremely rare. It appears as a slow-growing, usually encapsulated mass, fairly soft but tough and lobulated, and on cross section and pressure exuding a glairy, mucinous fluid. Myxomata are found most especially in the bones, muscles, subcutaneous and subserous tissues, along the course of nerve trouble, in the neighborhood of joints and in the umbilicus. It must be remembered, however, that a myxomatous degeneration of a fibroma, chondroma or lipoma is very frequently found and presents in a general way the picture of a true myxoma. At times myomata or tumors with myxomatous change show a tendency toward extreme rapidity in growth and assume most malignant characteristics.

Neuroma is a tumor composed of nerve-fibers and nerve-cells. The true neuromata are extremely rare, and when found are usually within the medullary portion of the suprarenal gland, the brain, the sympathetic ganglia of the thorax and abdomen, and in the skin. This type of tumor is also found in the retina, and, following in a general way the commonest rule of neuromata, is of congenital origin. This tumor is most frequently found in the infant, although occasionally it occurs in the adult. It should be remembered that the type of tumor known as an *amputation neuroma* bears no definite relation to the true neuroma, but represents simply an hyperplasia of the nerve fibrils.

Osteoma.—This is essentially an entirely benign and slow-growing bony tumor, spherical or tuberosus in contour, of stony hardness, attached to the underlying tissues and showing a tendency toward compressing the surrounding tissues but retaining intact its sharply defined margin. Its size is of extreme variability, appearing at times to an extraordinary proportion, pushing and pressing upon the tissues, causing the most hideous deformities. Two varieties are distinguished, first the *cancellous* osteoma, and secondly the compact or *ivory* osteoma. The tumor is usually limited to the osseous system. The skull, long bones and ribs are the most common sites, though any bone may be affected. Two subdivisions may be considered: First, the *enostoses*, which arise in the interior of the long bones and project into the medullary cavity; second, the *exostoses*, which arise from the outer surface of the bone. A rapidly growing, bony tumor should always be considered as having undergone sarcomatous change.

Papilloma.—This is a benign growth of branching strands of epithelial cells with a subjacent connective-tissue stroma which carries the small blood-vessels into each prolongation. Papillomata occur in a large variety of forms, being either hard and horny or soft and edematous, depending upon whether they arise from cutaneous, mucous or serous surfaces. On the skin they occur most commonly on the face or anal or genital regions. They may have a short stalk and be deeply indented. Of a more simple nature are the common *warts*, which occur characteristically on the hands. The epidermis is thickened and horny, this form of papilloma being only slightly raised above the surrounding skin. Papillomata occur fairly frequently in the mucous membrane lining the mouth, pharynx or nasal cavities. These are usually pedunculated and soft; the epidermis may be thinned out or ulcerated away, due to irritation or inflammation. In the urethra, vulva and vagina there occur papillomata which must be differentiated from condylomata and hyperplastic epithelial growths due to infection. In the stomach and intestinal tract, papillomata are not as frequent as adenomata. In the bladder and on the surface of the ovary, papillomata are occasionally present.

Rhabdomyoma represents a striated muscle tumor and is rare, though occurring occasionally in the various viscera. It should not be considered of sufficient clinical importance to warrant discussion in this text.

Xanthoma is characterized by its peculiar yellow color, occurring most especially in the folds of the skin, as in the groin, the eyelid, the neck and on the face. It is nodular in contour, the nodules being more or less flat or rounded. It is essentially a tumor of middle age or advanced life. Diabetes is supposed to be a predisposing cause.

MALIGNANT TUMORS

Carcinoma is a malignant tumor of epithelial tissue occurring in practically every region of the body. It is most common in those tissues which are subject to repeated irritation, such as the skin and intestinal tract, or those which undergo periodic changes, such as the uterus and female breast. It is rare in early life, but after thirty increases rapidly in incidence to fifty-five or sixty years. The special type depends on whether the tumor arises from squamous, columnar or cuboidal-celled epithelium; hence carcinoma of each tissue has distinctive features. But all of them have an unlimited growth of tumor cells, which metastasize by lymph-

and blood-vessels, spread by direct extension, have no limiting capsule, become adherent to surrounding tissues, are usually very hard and firm, tend to grow rapidly, cause increasing cachexia, and, eventually, death.

From squamous cells arise the *epitheliomata*, and the common skin cancers, *rodent ulcers* or *basal-cell* carcinomata. These seem to be most common where there is a transition from one variety of epithelium to another, such as the edge of the lip, nostril, eyelid, vulva and anus. A characteristic carcinoma of the lip follows prolonged, slight traumatism, causing the formation of a superficial ulcer which refuses to heal, but bleeds when the crust is removed. Induration occurs, the ulcer widens and deepens into a crater, the regional lymph-nodes become involved and metastases occur in distant organs, particularly the liver. Similar types of tumors occur in the esophagus and cervix uteri. *Basal cell carcinomata* are most frequently found on exposed portions of skin; the face and back of the hands. Necrosis and ulceration cause large, irregular, ragged, crater-formed tumors. This variety is relatively benign, in that they grow slowly and do not tend to metastasize. Carcinomata arising from a columnar epithelium are very malignant, rapidly growing, metastasizing early and giving rise to secondary growths, often much larger than the primary tumor. These are found in almost every region of the body, but the viscera most frequently involved are the stomach, large intestine, gall-bladder, pancreas, body of the uterus, and, less often, the prostate. In the stomach the growth may be polypoid, solid, scirrhous or colloid. Because of the nature of the cells from which these tumors arise they are often termed *adenocarcinomata*. For full discussion see under organ involved. From cuboidal epithelial cells there arise carcinomata very similar to the adenocarcinoma and a distinction has little justification. This form is very commonly found in the breast, rarely in the thyroid, liver, ovary and prostate. They seem to follow prolonged irritation or senile changes, occur in several forms, such as *scirrhous*, or *colloid*, are usually rapid in growth, metastasize early and eventually cause death. See "Breast" for complete description.

Chloroma is a tumor of lymphatic tissue resembling lymphosarcoma. It is composed of malignant cells containing a greenish pigment, hence the name. Males under twenty are most commonly affected, the disease running a very rapid course to a fatal termination in an average of five and one-half months (Ewing). In older patients the disease runs a more chronic course. The tumors arise chiefly from the bones of the skull and face so that early symptoms center about the eye, ear, nose and throat. Occasionally the sternum and vertebræ, rarely the long bones, are affected. The cervical, axillary and mediastinal lymph-nodes are always involved. Deposits of the tumor are found in practically every organ of the body.

Endothelioma is a tumor arising from endothelial cells which live in blood- and lymph-vessels, cerebrospinal spaces and possibly in the pleura and peritoneum. Under this term a great many otherwise unexplained tumors have been classified, so that this word may cover *psammomata*, mixed tumors and several forms of sarcomata. MacCallum states that in practically no case has the origin of a tumor from endothelium been proven. Tumors of the dura mater, usually called *psammomata*, are generally considered as true endotheliomata. They contain calcareous particles, lie on the surface of the brain, or are imbedded into its substance and may cause serious trouble by pressure. They are benign, encapsulated, and after being easily separated from the brain tissue, do not recur. Tumors termed endotheli-

omata are found on the peritoneal or pleural surfaces, but most observers consider them as arising from epithelial cells. They occur as dense layers of cells covering the lung, which is usually invaded. These are usually of a malignant nature, grow rapidly, metastasize to lymph glands and give rise to secondary growths. True endotheliomata arising from blood-vessels are extremely rare, but many reports of tumors thought to be of this nature are in the literature.

Atypical or Malignant Lymphoma.—*Lymphadenoma* is one of the atypical forms of lymphoma and is a malignant swelling of the lymph-nodes. It is progressive, extending from group to group, and associated with anemia. It often metastasizes to the abdominal viscera. The disease occurs most frequently in males under forty and may arise in chronically inflamed glands. The process may be generalized when the first symptoms appear, or the condition may be confined to one group of glands for some time. The glands of the neck are usually those first involved, either both sides or extension to the opposite side occurring after several weeks. At first the glands are discrete, movable and hard with no involvement of the overlying skin. As the condition progresses the glands coalesce, become fixed and may form such large masses that respiration and swallowing are difficult. Extension may take place by rupture through the capsule of the gland, and rarely the skin becomes adherent and ulcerated. Signs of intrathoracic pressure denote extension to the mediastinum. The leukocyte count may be increased, but it is often normal with a relative lymphocytosis. Anemia increases, the spleen enlarges and slight fever may be present. The disease is of a most malignant nature and is rapidly fatal. See "Sarcoma" for discussion of lymphosarcoma.

Myeloma is a malignant tumor arising from the bone-marrow and usually is in multiple foci. It occurs in the ribs, sternum, vertebræ and other bones. There are lymphoid and myeloid forms, but clinically they are similar. The cortex of the affected bones is encroached upon so that it becomes thinned out, brittle and the seat of numerous fractures. The disease develops slowly in advanced or middle life, and is ushered in by pains in the extremities and weakness. These may continue for some time, but eventually tender tumor masses appear, especially in the back and chest. Albumosuria (Bence-Jones protein) is present. Progressive weakness and exhaustion precede death.

Sarcoma is a malignant tumor developing from connective tissue. The histology of sarcomata is so varied that classifications are numerous and more or less unsatisfactory. Their early diagnosis is most important in as much as, at times, they represent the most deadly form of disease. The blood supply of these tumors is, as a rule, very abundant, which in itself tends toward rapidity of growth. At times the growth is so slow as to confuse one with the possibility of an existing benign tumor. Metastasis by way of the blood stream is generally the rule. Any part of the body may be affected by the sarcomata, though they are most commonly found in the skin, the bones and periosteum, the intermuscular planes of connective tissues, the parotid gland, the ovary, the lymph glands, the retina and the blood-vessel walls. The various benign tumors of connective tissue origin, such as the fibroma, chondroma, osteoma, etc., are prone to sarcomatous degeneration and it is not infrequent to see a slow-growing benign tumor suddenly assuming a rapidity of growth, infiltrating and invading the surrounding tissues and showing signs of metastasis within a short period of time. Sarcomata are essentially tumors of

infancy, youth and early adult life, but may occur at any age. A general classification is necessary, based as it were on the pervading type of cell found. Clinical differences are thus often noted in the various types. Thus, the *round-cell sarcoma*, whether of small or large cell variety, is a rapidly growing and fatal tumor giving rise to early infiltration of the surrounding tissues and early signs of metastasis, especially to the liver, spleen, lungs, and kidneys. It is characterized by its general regularity of contour, its primary mobility and the early fixity to the skin and underlying tissues, its fair degree of softness and its white, homogeneous and vascular appearance on cut section. The small, round-cell sarcoma is more rapid in its growth than is the large, round-cell type. Pathologists often classify the *malignant lymphoma* or *lymphosarcoma*, as being a variety of the *round-cell* class. It is supposed that these tumors are clinically identical with the round-cell sarcoma, with the possible exception of their being found more frequently in very young persons and having a predilection for the subpleural and subperitoneal surfaces. The *spindle-cell* sarcoma is less rapid in growth than is the round cell, and of harder consistency, often resembling, to the feel, a fibroma. Invasion of the surrounding tissues and fairly early metastasis is characteristic. The periosteum, bone, parotid gland, ovaries and testicles are its most frequent sites. The *melanotic* sarcoma is the pigmented form and its characteristics are its distinctive light or dark brown color, its frequent occurrence within or beneath pigmented spots or pigmented moles on the skin, its very rapid dissemination throughout the body, with a tendency towards first extending along the lymphatics, and affecting the regional lymph-nodes; it then spreads to other parts of the body by means of the blood stream. Fifteen per cent of all melanomata have been primarily subungual. (N. A. Womack, *Arch. Surg.*, 1927, 15:667-676.) These have appeared as shallow, granulating, non-healing ulcers in the nail-bed of patients over forty. The anus and vulva are occasionally involved, as is also the choroid coat of the eye. It should be remembered that at any time, especially in middle life, pigmented moles are apt to show sarcomatous changes.

Mixed tumors of the salivary glands are the result of misplaced embryonal tissue and contain structures from two or all of the blastodermic layers. On microscopic examination they are found to consist of a richly cellular tissue made up of epithelial or endothelial cells arranged in a reticular manner, with islands of cartilage or other structures and areas of mucoid degeneration. These tumors are present at birth, but may not increase to a size sufficient to give symptoms until puberty or later. They occur most commonly in the submaxillary and parotid glands, which cannot be palpated separately from the tumor. If benign, or very recently malignant, the mass will be freely movable, with a nodular surface. A mixed tumor, even though it has been benign for years, may become malignant at any time; it then rapidly increases in size, and becomes fixed to surrounding tissues. When the parotid gland is involved in a malignant growth there will be an increasing facial paralysis and radiating pains. Mixed tumors of the kidney occur in infants and young children, often increasing to such a size as to distend the whole abdomen. They are made up of a complex arrangement of structures, those most frequently present being fat, cartilage, smooth muscle, connective tissue and epithelium. They do not give rise to hematuria, as do the hypernephromata, but cause symptoms only by their mechanical pressure.

Mixed tumors of the testicle are fairly common. They are made up of strands of large round cells and have been termed round-cell sarcoma and adenocarcinoma. These tumors are often rapidly malignant, extension and metastases taking place along the spermatic cord and through the veins.

CHAPTER IV

THE HEAD

AFFECTIONS OF THE SCALP

Injuries	wound	contused
		incised
	contusion	lacerated
		puncture
		gunshot
	hematoma	cephalhematoma
		cephalhydrocele (traumatic) or false meningocele
		superficial
		deep (subaponeurotic)
Inflammatory conditions		cellulitis (acute diffuse)
		furuncle
		carbuncle
		subpericranial abscess
		erysipelas
Granulomata	{	tuberculosis
		syphilis
Aneurysm	{	cirsoid
		arteriovenous
Nerve manifestations	{	hyperesthesia
		neuralgia
Tumors	benign	angioma
		dermoid cyst
		fibroma
		hemangioma
		keloid
		lipoma
		papilloma
		pigmented mole
		pneumatocele
		sebaceous cyst
	malignant	carcinoma
		epithelioma
		basal cell
		sarcoma

History

Age

Personal History.—Long standing or recent irritations of the scalp, such as eczema, warts or tumors. Infections of the nose, ears, mastoid cells, antrum or frontal sinuses; tuberculosis and syphilis.

Present Illness.—Trace course of disease from its earliest inception to present time, and determine relation between present condition and preëxisting disease. Pain: type and radiation.

Physical Examination.—Carefully describe area involved, including appearance, location, presence or absence of ulceration or fluctuation; condition of skin over diseased area, and size of regional lymph glands. If tumor is present, describe it in detail, including size, location, movable or fixed, tenderness on pressure, single or multiple, pulsation, murmur or thrill, condition of skin over mass, signs of inflammation, presence of thrill or murmur. Effect of mass on pressure; is it decreased and is pulsation or thrill or murmur diminished? Are the skin and the immediate subcutaneous structures only involved? Is there an involvement of the fascial and muscular planes? Has the periosteum been separated from the skull? Is there an accompanying skull involvement? Have any of the large vessels or nerves been injured or divided? Is there present hair, dirt or other foreign bodies or materials within the wound? Are there signs of infection (Johnson)? *In puncture and other types of wounds that are more or less inaccessible, a sterile probe may be used carefully. The examination should be conducted with the greatest aseptic care and caution.*

Injuries

Scalp wounds are of such frequent occurrence that their presence is often looked upon with too minor a degree of import, and hence it is that so often skull and cerebral injuries are not recognized at the time of first examination. Wounds in this region may be of the same variety as seen elsewhere in the body, and are divided into the *contused, incised, lacerated, puncture* and *gunshot* wounds. Owing to the skull convexity, more *incised* wounds, caused by blunt instruments and blows, are found here than in any other part of the body. Their extent and depth vary with the causative agent and the area involved. Three types of scalp wounds are recognized; namely, those which are extremely superficial, those which extend to, or penetrate the fascial or muscular planes, and those which penetrate to, or through the periosteum to the bone. The superficial wounds may bleed profusely and their edges will not, as a rule, gape. Those wounds which extend to, or through the fascial or muscular planes, will usually show a decided gaping, and a true "depth" will be noted. Those wounds which extend through the periosteum to the bone itself are likely to present a certain amount of roughness to the feel; this is due to a retraction of the periosteum, often leading the examiner to feel at first that there has been a crack in the outer table of the skull. It should always be borne in mind, however, that a non-gaping wound does not eliminate the possibility of injury to the cranium. It is essential that the utmost care and thoroughness be used when *examining* and determining the extent of a scalp wound.

Cephalhematoma is a swelling made up of extravasated blood, and located between the skull and periosteum. It is most especially found in infants and very young children, following a difficult labor, and in those of a rachitic and tuberculous diathesis. This condition is usually found over one or both parietal bones, terminating at the sutures and is recognized by its fluctuation, non-pulsation, location and history. By the term *traumatic cephalhydrocele* is meant a swelling

of the scalp caused by an extravasation of spinal fluid, which develops as a tumor mass between the skull and the scalp. The history of former skull injury, the age of the child, which varies from one to four years, the reduction of the swelling when pressure is exerted, the recognition, after such reduction, of skull edges and the pulsating mass (not always present) are typical of the condition. Occasionally this condition is referred to as *false meningocele*.

Hematoma of the scalp is one of the most common sequelæ of a contusion of the scalp. It is essentially an accumulation of blood over a circumscribed area of the scalp and appears within the subcutaneous tissues or beneath the aponeurosis, in which instance it is called a deep or "subaponeurotic hematoma." In the superficial form it appears as a semifluctuant swelling, which is movable from the skull. A deep hematoma, on the other hand, appears as a non-mobile semifluctuant swelling whose borders are firm and elevated, with often a depression in the center—this condition is often confused with a depressed fracture of the skull. The examining finger can usually differentiate the condition by pressing the infiltrated border of the hematoma so that when the blood-clot is stroked or pressed away from the periphery, the sense of depression disappears.

Inflammatory Conditions

Acute diffuse cellulitis is an acute inflammatory condition, widespread in extent, and invading the fascial layers so as to represent a condition severe in character, and often of most serious prognosis. A hardness and brawniness, with scattered areas of semi or complete fluctuation, develop, which at times may extend over the entire scalp. Tenderness of the affected part is almost constant. Severe headaches, chills and fever and general signs of toxemia are usually present, leading at times to an acute delirium. The cervical lymph glands are generally enlarged and tender. The condition usually follows scalp wounds, and as the infection progresses, secondary osteomyelitis of the cranial bones occurs. The intracranial sinuses and meninges may become invaded.

Furuncles are not uncommon and are most often situated in the thick cellular tissues at the back of the neck. Tenderness is pronounced, and there appears a central point of suppuration, surrounded by a fairly circumscribed area of infiltration.

Carbuncle represents the more advanced stage of a furuncle, with a widespread area of infiltration surrounding a circumscribed mass, having multiple foci of suppuration. The occipital portion of the scalp is most frequently affected. Constitutional symptoms may or may not be pronounced. Sugar may be found in the urine and the blood-sugar index may be increased.

Subpericranial abscess often follows a secondary infection of a cephalhematoma (postoperative or traumatic) and may be secondary to an osteomyelitis, following ear or mastoid disease, though it may be hematogenous in origin. Tenderness and at times fluctuation may appear over the affected area, and constitutional symptoms may be severe.

Erysipelas of the scalp is usually secondary to wounds of the face or scalp, and suppurative processes in the nasal fossæ, ear, antrum or frontal sinuses. Constitutional symptoms such as headache, malaise and chills, followed by a pro-

nounced rise in temperature, may antedate local signs by hours or a day. The etiologic wound may heal well and may not be affected by the infection of the scalp, or it may become suppurative and covered with a membranous exudate. The local signs appear as a tense infiltration of the scalp, which becomes red, swollen and edematous; sharply defined edges, demarking it well from the surrounding skin, are present. Bullæ may or may not be noted. Superficial and deep-seated abscesses often form, causing, at times, definite areas of fluctuation. Streptococcic infection of the orbital tissues with an accompanying edema of those parts is not uncommon. Venous sinus invasion, followed by pyemia, is occasionally encountered.

Granulomata

Tuberculosis of the scalp most commonly occurs as a secondary infection from a tuberculosis of the cranial bones, due especially to mastoid or middle ear disease, or to a generalized tuberculosis. The lesion may present as a definite abscess with fluctuation, or as a tuberculous ulcer. *Lupus* occasionally presents as a secondary extension from the face.

Syphilis appears in the primary, secondary and tertiary forms. The chancre is extremely rare, though the lesions of the secondary stage, exhibiting themselves as macules, papules and pustules, are not uncommon. *Gummata* appear as circumscribed, freely movable, painless nodules in the skin or deeper portions of the scalp. They are at first firm to the feel, but often break down into fluctuant masses.

Aneurysm

Cirroid aneurysm is a condition which appears as a mass of dilated and tortuous blood-vessels (the temporal artery and its branches and the occipital artery are the favorite blood-vessels which are involved), forming a fairly irregular and slightly elevated mass upon the side of the head, usually about the temporal or occipital regions. The overlying skin is either normal or somewhat thickened and is in marked contrast to the bluish and tortuous vessels making up the mass. The tumor is soft and compressible, painless, pulsates and presents to the ear a soft, intermittent, blowing murmur. Pressure upon the carotid artery on the same side may or may not diminish the size or the murmur.

Arteriovenous aneurysm invariably follows injury, and may or may not be noted in the same location as the cirroid aneurysm. The veins are markedly dilated, while the arteries leading to the mass are generally normal. The growth is fairly rapid. The murmur is continuous, while in the cirroid type it is intermittent. Pressure on any part of the tumor causes a cessation of murmur, pulsation and thrill.

Nerve Manifestations

Hyperesthesia may be referred to the scalp from neighboring tissues, but is most commonly seen in association with local inflammatory lesions of the dura mater.

Neuralgia of the scalp is most especially encountered in the supra-orbital and suboccipital areas and may be extremely painful and persistent. Scars, pressure from tumors, and postzoster lesions often are etiologic factors.

Tumors

(See chapter on "Tumors.")

HISTORY OF HEAD INJURIES

From Patient or Witness

*Questioning*Accident { date
hour

Mental condition	{	aphasia	{	immediate	
		amnesia			subsequent
		apathy			
confusion	unconsciousness	{	duration		
				excitement	intermission

Headache { location
severity
constant or intermittent
time of first appearance

Pain	{	location	{	ears
				eyes
				nose
				"behind eyes"
		severity	{	time of first appearance
type				

Dizziness { severity
duration
constant or intermittent
time of first appearance

Tinnitus aurium

Convulsions or twitchings	{	local or general	
		site of first appearance	
		time of first appearance	
		severity	
		duration	
		{	description of progression

Numbness and tingling { location
site of first appearance

Paralysis or paresis	{	location
		extent and severity
		description of progression
		site of first appearance

Vomiting { onset
frequency
type { projectile
regurgitant

Hemorrhage { location { ears
nose
mouth
severity
time

Inspection

Decubitus

Mental condition { unconsciousness { immediate
subsequent and duration
duration of intermission if present
coma
aphasia
amnesia
apathy
stupor
confusion
excitement

Skin { abnormal flushings
abnormal sweating
cyanosis

Mucous membranes { cyanosis
pallor

Respirations { rapid or slow
shallow or deep
stertorous or quiet
Cheyne-Stokes

Injury { Complete description of visible injury includes type, location, bleeding from wound, escape of spinal fluid or brain substance, swelling or tumor mass and pulsation

Hemorrhage { wound
ears
eyes
nose
mouth
subconjunctival
Is bleeding increased by coughing and exertion?
Thoroughly examine ears, nose and mouth for bleeding sites

Ecchymosis { eyelids
mastoid region
nape of neck
orbital region

Subcutaneous emphysema { mastoid region
nape of neck

Eyes { pupils { equal or irregular
contracted or dilated
reaction to light and if conscious to accommodation
exophthalmos (with or without pulsation)
nystagmus
complete ophthalmoscopic examination

Tongue { protrusion { midline
to right
to left
tremor

Convulsions and twitchings { location
local or general
intermissions (duration)
unconsciousness preceded by aura
position of head during attacks

Scars { location
extent

Palpation

Head { swelling { location
contour
consistency
size
pulsation
depression { location
contour
size
surrounding tissues
tenderness—location

Skin { surface temperature

Extremities { muscular rigidity
muscular weakness (paresis or paralysis)
resistance to active motions, if conscious
resistance to passive motions, if unconscious
anesthesia (areas of)
analgesia (areas of)
hyperesthesia (areas of)

Pulse { rate
rhythm
quality

Orbital notches (reaction to pressure)

Reflexes { ankle
abdomen
knee
cremaster

Cranial nerves (tests for abnormality)

Sphincters

Blood-pressure

Urine (glycosuria)

Spinal puncture

AFFECTIONS OF THE SKULL

Malformations	{	congenital	{	anencephaly
				meningocele
				encephalocele
				microcephaly
	{	acquired	{	acromegaly
				craniotabes
				hemifacial atrophy
				leontiasis
				osteitis deformans
				osteomalacia
				rickets
			{	senile atrophy
Injuries (fracture)	{	vertex	{	simple {linear
				depressed
		compound	{	linear
				depressed
				gunshot
	{	base	{	simple {linear
				depressed
		compound	{	linear
				depressed
				gunshot
			{	with or without brain injury
Inflammation	{	acute	{	traumatic
				extension
				metastatic
	{	chronic (as sequela to acute)		subperiosteal abscess
				necrosis
Granuloma	{	tuberculosis	{	primary
				secondary
	{	syphilis	{	periostitis
				gumma
Cysts	{	parasitic		
		usually echinococcus		
Tumors	{	benign	{	chondroma
				exostosis
				osteoma
	{	malignant	{	carcinoma
				myeloma
				chloroma
				sarcoma

Malformations

Congenital.—The skull conforms to the shape and size of the underlying brain, and various conformations occur. Gross congenital malformations are not common. In instances of *anencephaly*, or absence of the brain, only a minute, deformed and deficient skull is present. In *hydrocephaly*, the skull is enlarged, sometimes to an

enormous size, in all diameters. Because of the increase in intercranial contents, the soft, flat bones of the skull are widely separated, with broad interspaces instead of suture lines, and with enlarged and open fontanels. *Meningocele* and *encephalocele* are congenital abnormalities in which there is a protrusion of the cerebral membranes and the brain itself, respectively, between the skull bones. This protrusion takes place through a suture, and usually occurs in the midline, at the vertex or at the base of the skull; it appears as a rounded, smooth mass, large or small, beneath the scalp, fluctuant in consistency, soft or tense. Occasionally it is reducible. Upon straining efforts, *i.e.*, coughing or crying, the mass becomes more tense. When reducible, the defect in the suture line may be palpated. Radiography demonstrates the condition very accurately. In *microcephaly*, the entire skull is unusually small, either symmetrically or asymmetrically.

Acquired.—These arise later in life, and vary considerably according to the particular affections. In *acromegaly*, the skull bones are thickened, the skull as a whole is elongated, as is the face, and the supra-orbital ridges are prominent. In *craniotabes*, soft, rounded or irregular areas are palpable throughout the skull. Slight or moderate pressure will indent the softened bone. *Hemiatrophy*, in which one-half of the skull is symmetrically smaller than the opposite side, occurs in association with facial or complete atrophy of one-half of the body. In *leontiasis*, the skull bones share in the smooth, rounded overgrowth which had previously affected the facial bones. The increase is noted particularly in the transverse diameter of the skull. In *osteitis deformans* (Paget's disease), deformity of the skull takes place, resulting in thickening of the bones, and a somewhat conical or pear-shaped appearance of the skull results. Radiographs exhibit a typical picture with overgrowth of the bones and softened areas, due to nutrition changes, which appear like flocculent, snowball-like masses, scattered throughout the skull. *Osteomalacia* also affects the skull, as it does other bones, with a resulting irregular flattening in some areas, and undue prominence of the bones in others. In *rickets*, the skull is square and boxlike, with high, bulging forehead and prominent bosses. Cranio-tabes may be associated. In *senility*, the skull bones undergo atrophy, similar to other structures, and it leads, at times, to malformations classified as *senile atrophy*.

Injuries

(Fractures)

(See chapter on "Dislocations and Fractures.")

Inflammatory Conditions

Acute varieties result from trauma, such as compound fractures or severe contusions; by direct extension, as from scalp, nasal, aural and meningeal infections; and by so-called metastasis from other sites of the body. Thus, the infection of the skull bones usually takes the form of an extension of the original condition. Any or all of the components of the skull, pericranium, skull tables, and diploë may be involved, with the exception that a true osteomyelitis, confined to the diploë, does not occur. The orbit is a favorite site. The process may be either localized or

diffuse and may cause either a limited perforation of the bones or a more widespread destruction.

Chronic inflammatory conditions of the skull bones result from former acute processes.

Subperiosteal abscess is very likely to be associated with symptoms of concealed pus—chills, high fever and rapid pulse—because of its confinement between the bone and periosteum. The accompanying swelling is very tender and painful.

Necrosis of the bones occurs in infective processes, and also in tuberculosis and syphilitic affections.

Granulomata

Tuberculosis of the skull occurs as a *primary* condition, or *secondary* to nasal and aural tuberculosis. In the primary affection, the frontal region is the site of selection. The first indication of tuberculous osteitis is a firm, fairly rounded swelling, small in size. This enlarges, becomes softer and finally fluctuates. In late stages, a sinus extends through the scalp, discharging yellowish-green pus or caseous material.

Syphilis appears in two forms, syphilitic *periostitis* and *gumma*. *Periostitis* appears as a rounded, usually tender swelling of the periosteum, small at first, but extending fairly rapidly and pursuing a chronic course. The swelling is firm and rather smooth upon palpation. The favorite sites are the frontal and parietal bones, especially the former. The x-ray, Wassermann reaction and response to specific treatment may be utilized in excluding periosteal sarcoma. Syphilitic *gumma* of the skull arises as a solitary lesion, or appears in multiple form. In the early stages, the swelling is moderately firm, fairly regular and non-tender. Growth may be either rapid or slow, although the course is usually chronic. Overlying, sloughing of the scalp with the formation of sinuses or ulcerations may take place. In some cases of multiple gummata, the process is diffuse and may involve a considerable portion of the skull. Productive and destructive processes go hand in hand, so that irregular, firm, bony overgrowths may be both seen and felt, alternating with areas of such softness that pressure will cause indentation. When the scalp has become involved, the discharging material is foul-smelling and necrotic, and often is secondarily infected. In isolated lesions the parietal and frontal regions are chiefly affected. Here, again, the history, other lesions, Wassermann, and therapeutic tests and radiography are important aids in diagnosis.

Parasitic Cysts

Parasitic cysts of the skull are very rare; of fifty-two cases of echinococcus cyst of bone collected by Tillmanns, four were present in the skull. They are minute cysts, slowly growing and may give no symptoms for many years. They may enlarge and cause a painful swelling of the scalp. The bone tends to necrose and break down without attempting to repair.

It is impossible clinically to diagnose this condition. An examination of the cyst's contents to determine the presence of hooklets, offers the only definite means.

Tumors

BENIGN

Chondromata are usually secondary, or rather, occur by extension, as from the nose. The shape is less smooth than that of osteomata, and the consistency may also be comparatively decreased.

Exostoses, or bony outgrowths of the skull, are also infrequent. They are small or fairly large, irregular or smooth, rounded or hooklike projections, and may arise spontaneously or secondarily to injury.

Osteoma, like chondroma, is not frequently seen. Osteomata occur principally on the frontal and parietal bones. When their extension is outward, as usually is the case, they present smooth, hard, rounded swellings of the bone, gradual in development and extremely chronic in their course. An osteoma, however, may grow from the inner table, resulting in irritative cerebral symptoms, such as headache, convulsions and muscle twitchings.

MALIGNANT

Carcinoma of the skull is a secondary affection, often occurring by extension from a scalp or facial malignancy. The bony invasion is from without inward, and is usually visible at the base of the malignant ulceration of the soft tissues. More frequently, multiple carcinomata arise in the skull by metastases from more distant original sites, especially the breast, thyroid, and prostate gland. There may be no signs or symptoms but radiography will demonstrate a diffuse infiltration of the skull, very similar in many respects to that of Paget's disease.

Myeloma arises in the skull, either primarily or in association with multiple myelomata of other bones, especially the ribs and vertebræ. It is typically a soft, rounded nodule, which produces a clean-cut perforation of the bone and appears beneath the scalp. The x-ray appearance is quite suggestive, especially when other bony lesions are discoverable. The finding of Bence-Jones bodies in the urine and the progressive bodily weakness are distinctive features.

Chloroma also occurs in the skull as a primary affection presenting a rounded, nodelike swelling, the physical characteristics of which are not remarkable. Associated leukemic changes in the blood may be noted, and point to the diagnosis, but, very frequently, surgical incision will be required to differentiate it from other affections.

Sarcoma is a primary or secondary affection, while *carcinoma* is secondary. Sarcoma may arise as a periosteal or osteogenetic new growth, presenting a firm, nodular mass which extends rapidly; smooth in the early stages, but assuming an irregular, invasive character as the growth advances. The overlying scalp, in the late stages, may exhibit redness and induration, and may become ulcerated. Probably more often sarcoma is primary in the meninges, involving the skull secondarily, so that the original symptoms are those of meningeal or cerebral tumor, and the bony encroachment is merely a secondary feature, which occasions no signs or symptoms until the affection is far advanced. Radiography is a very important adjunct in diagnosis. Primary sarcoma is most apt to attack the parietal and frontal

bones, in order of frequency, but it may occur in any part of the skull. A very large sarcoma of aural origin often exhibits pulsation.

INJURIES OF THE BRAIN

(For added discussion see "Fractures of the Skull.")

Concussion

Compression

Contusion

Laceration

Hemorrhage	{	middle meningeal (trunk or branch)
		smaller arteries of pia
		subdural
		vertebral
		internal carotid
		arteriovenous aneurysm
		venous sinuses

Sinus thrombosis

Cranial nerve injuries

Concussion.—Concussion of the brain is characterized by temporary loss of consciousness in association with brain injury. Trauma to the head, fractured skull, severe blows on the lower jaw, and falls on the feet, knees or buttocks may produce cerebral concussion.

In mild cases, there is bewilderment or confusion, which passes off within a very short time. In the more typical variety, there is immediate unconsciousness, not amounting to actual coma. This is accompanied by vomiting, dilated pupils, rapid pulse and normal or subnormal temperature. Sweating is common; the face is pale and extremities cold. The general picture is that of shock. The reflexes are usually present, and it may be possible to arouse the patient. Unconsciousness disappears in a comparatively short time. Vomiting and restlessness often develop as consciousness returns, the vasomotor functions also resuming an improved state.

Concussion may advance to the stage of cerebral compression. Severe grades of concussion extend over a period of several hours, and may be fatal.

Compression.—This is a more severe brain injury, associated with prolonged unconsciousness and produced, for the most part, by hemorrhage within the skull. Coma is the characteristic symptom. This may come on at once, may develop slowly, or may appear only after an interval. When complete, all reflexes, including the organics, are lost. The pupils are dilated, or unequal, without reaction to light, and there may be conjugate deviation of the head and eyeballs. The pulse is slow, regular or irregular, and its tension is increased. As the pulse rate decreases and the compression becomes greater, the blood-pressure rises. The face is often flushed, the respirations are stertorous and may be irregular and the temperature is frequently elevated. Even in early stages, congestion of the retinal veins is found;

DIFFERENTIAL DIAGNOSIS—CONCUSSION, COMPRESSION, CONTUSION AND MIDDLE MENINGEAL HEMORRHAGE

Symptom	Concussion 1. mild; 2. moderately severe; 3. severe	Compression 1. mild; 2. severe; 3. advanced with paralysis	Contusion or Laceration	Hemorrhage (Middle Meningeal)
Onset	1. Immediate 2. Immediate 3. Immediate	Usually determined by etiologic factor, thus: Depressed fracture and spicules—almost immediate. Intracranial hemorrhage—immediate, followed by free interval or interval between accident followed by compression symptoms; or may be no perceptible interval between signs of concussion and compression. Extracranial hemorrhage—usually early. Pia or sinus hemorrhage—usually later than the above and less marked. Tumor—slow.	Immediate, due usually to symptoms of concussion or compression.	Four stages: (a) Symptoms of concussion—free interval—symptoms of compression. (b) Symptoms of concussion—no free interval—symptoms of compression. (c) Symptoms of compression, immediately. (d) No symptoms of concussion—free interval—symptoms of compression.
Mental condition . . .	1. Unconsciousness—few seconds to a few minutes, followed by period of retrograde amnesia and confusion. 2. Unconsciousness—number of hours followed by great confusion and retrograde amnesia. 3. Unconsciousness up to time of death. If recovery, great confusion and retrograde amnesia.	1. Delirium, irritability, excitement, restlessness, retrograde amnesia and perhaps coma. Patient may be aroused by external stimuli. 2. Coma. 3. Coma.	Unconsciousness—length of time depending upon the extent of lesion and severity of concussion or compression. If recovery, great confusion, excitability and retrograde amnesia ensue.	(a) Unconsciousness (usually short period), followed by consciousness though patient is drowsy, perhaps dizzy, complaints of headache; this is followed in short time by semi-unconsciousness or complete coma. (b) Unconsciousness which lasts until time of death. (c) Unconsciousness which is lasting. (d) Often no mental signs at first, followed in few minutes or hours by unconsciousness.

Reflexes	1. Normal. 2. Usually normal, but if patient is unconscious, tendon reflexes abolished. 3. If comatose, tendon reflexes are abolished. If acute edema is present without entire unconsciousness, tendon reflexes may be increased.	1. If comatose reflexes are abolished, otherwise negative. 2. Abolished. 3. Abolished and if pyramidal tract is involved Babinski is present.	Depending upon the severity of the compression. If complete coma is present, tendon reflexes are abolished.	Depending upon the severity of compression. If complete coma is present, tendon reflexes are abolished. Usually exaggerated at first, then abolished.
Convulsions or twitchings	1. No. 2. Often general twitchings, occasionally general convulsions. 3. Occasionally there may be general convulsions.	1. Occasionally twitchings or convulsions or both, the site being dependent upon the part involved. 2. Fairly marked twitchings or convulsions or both are usual, the site of such being dependent upon the part involved. 3. Focal signs are marked.	Local or general convulsions and twitchings are commonly found, the severity and site of focal signs depending upon the extent of the lesion. May be entirely absent.	Extent and location depend upon whether the hemorrhage is large or small and whether it is directly over important centers. When small and localized near and not directly over important centers, local spasms, convulsions, jacksonian seizures, sometimes limited to face and eye muscles, occur. If hemorrhage is large and situated over an important center a spastic type of hemiplegia with rigidity occurs, though very extensive convulsions of particular areas are not uncommon. It is a quite usual occurrence to note a twitching of the hand, arm or face, followed shortly by convulsive movements of the same sets of muscles. If the hemorrhage is extensive the leg muscles may become involved in the same manner as the above.

DIFFERENTIAL DIAGNOSIS—CONCUSSION, COMPRESSION, CONTUSION AND MIDDLE MENINGEAL HEMORRHAGE (*Continued*)

Symptom	Concussion	Compression	Contusion or Laceration	Hemorrhage (Middle Meningeal)
Paralysis or paresis	1. mild; 2. moderately severe; 3. severe	1. mild; 2. severe; 3. advanced with paralysis	Yes, depending in extent upon site and severity of lesion.	Extent and location depend upon whether the hemorrhage is large or small and whether it is over important centers. When small and localized near and not directly over important centers, weakness of small groups of muscles, perhaps of face, eye, hand, arm, etc. If hemorrhage is large and directly over important centers we may have a complete spastic hemiplegia or only a complete paralysis of one or more extremities.
	1. No. 2. Splinters, temporarily. 3. Vasomotor and other centers in medulla, sphincters.	1. Often weakness of extremities, extent being dependent on part involved. 2. Often weakness of extremities, perhaps complete hemiplegia. 3. Paralysis very marked, the site of such depending upon the part involved.		(a) Usually of hand, arm, or one side of face. (b) Same as (a). (c) Almost immediate of hand, arm or one side of face. (d) May be markedly delayed. It should be borne in mind that motor aphasia may come on, if the lesion is on the left side and with right-handed individuals.

Respirations	1. Normal or slightly slower. 2. Slow and shallow. 3. Shallow and rapid	1. Slow and regular. 2. Very slow, stertorous, perhaps Cheyne-Stokes. 3. Shallow, irregular, Cheyne-Stokes.	Concussion and compression severity may cause changes, but this condition in itself gives no change unless medulla is involved, when respirations become rapidly feeble, preceded by slow breathing. Cheyne-Stokes.	Same as in concussion and compression.
Eyes, including pupils	1. Normal. 2. If comatose, pupils are reactionless. Otherwise equal, react to light and accommodation, contracted or dilated. 3. If comatose, pupils are reactionless, otherwise are equal, react to light, perhaps to accommodation. Contracted or dilated.	1. Pupils, contracted and unequal. May or may not react to light. Possible choked disk. 2. Pupils, dilated and unequal. Reactionless. Choked disk. 3. Often conjugate deviation. Pupils dilated and reactionless. Choked disk. If basilar or involving occipital lobe, may have hemianopsia.	Pupils dilated and reactionless. If basilar or involving occipital lobe, may have hemianopsia.	Pupils irregular and contracted at first, later dilated. Pupil on side of the lesion either dilated or contracted. Conjugate deviation of the eyeball to side of lesion. Choked disk. When the pupil irregularity is very marked it indicates severe brain compression (Hutchinson's pupil). Cranial nerve symptoms may present, depending upon site and severity of hemorrhage.
Pulse (P)—Temperature (T)	1. P. normal—T. normal. 2. P. slow and small—T. slight rise. 3. P. rapid and weak—T. great rise—subnormal.	1. P. Somewhat slower.—T. Normal or slight rise. 2. P. Very slow, high tension.—T. Rise. 3. Rapid, weak. T. Rise—subnormal.	P. slow, then rapid—T. variable.	P. Same as in concussion and compression. T. Not affected, unless medulla is involved.
Spinal puncture	1. Negative. 2. Negative. 3. Usually negative.	Increased tension.	Dependent upon severity of lesion. May be blood.	Increase tension. May be blood.

and, in advanced stages, there is *choked disk*. Paresis and paralysis can be determined when coma is incomplete, or when coma recedes. Facial palsy is apparent at any time, of course. Other cranial nerves may also be affected. If hemorrhage is intradural, the fluid obtained upon spinal puncture is bloody.

Cerebral compression is associated with intracranial tumors and cysts, and with cerebral hemorrhage, and hydrocephalus. It is also associated with cerebral contusions and lacerations.

Contusion and Laceration.—Cerebral compression usually occurs in these lesions, but may be absent. Contusion and laceration are most common in penetrating wounds, such as those caused by bullets, and can only be diagnosed when localizing symptoms develop. If the brain injury is in one of the "silent" areas, such symptoms are lacking. Contusion or laceration of the motor or sensory areas, or of any of the particular centers, such as that for writing, will produce easily recognizable disturbances. These injuries may be either irritative or paralytic. The prognosis in contusion is much better than in laceration. Permanent defects, too, may ensue after laceration. In any case of brain injury associated with high temperature from the onset, laceration of the brain should be suspected.

Hemorrhage.—Intracranial bleeding accompanies most of the cerebral injuries, and is the principal cause of cerebral compression. In concussion, hemorrhage is not usually remarkable, but some bleeding from the meningeal vessels and punctate hemorrhages in the brain itself are frequently observed. Hemorrhage from the principal arterial trunks, the internal carotid, for example, is very rare. It may result from gunshot wounds and other penetrating injuries, and is rapidly fatal.

Meningeal or extradural hemorrhage is the rule in cerebral injuries. It may be small or large in amount. When a fractured base of the skull has resulted, the blood may escape through the nose, pharynx and ears. The middle meningeal artery and, in particular, its anterior branch, is the source of most instances of meningeal bleeding. In general, the symptoms produced by extradural hemorrhage are those of cerebral compression, rather than those of internal hemorrhage. Nerves at the base of the skull, notably the facial, auditory and oculomotor, may be compressed by hemorrhage. A possible late result is chronic subdural hematoma. Initial unconsciousness, followed by a lucid period and then a return to unconsciousness, is diagnostic of meningeal hemorrhage.

Subdural hemorrhage, arising from the *smaller vessels of the pia* and the brain itself, is much less common. The symptoms, likewise, are those of compression of the brain. Subdural hemorrhage can be diagnosed by the presence of blood in gross quantity in the spinal fluid. Lumbar puncture is thus the only differential point between subdural and extradural hemorrhage. Reasoning conversely, one may recognize extradural hemorrhage in cerebral compression when the spinal fluid is clear.

The *vertebral artery*, at the base of the skull, is rarely injured. Penetrating missiles may accomplish this, or the vessel may be penetrated by a splinter of bone from fractures about the foramen magnum.

Blood-vessel injuries at the base of the skull, resulting in traumatic communication between the *cavernous sinus* and the *internal carotid artery*, produce the condition known as *pulsating exophthalmos*. The eyeball protrudes, there is chemosis of the conjunctiva and there may be a visible throbbing of the entire eyeball,

synchronous with the heartbeat. Upon auscultation over the globe, there is a loud, blowing murmur. This may be heard over other parts of the skull as well. The affection is progressive, is accompanied by blindness and is complicated by extensive destruction of structures of the eye. *Arteriovenous aneurysm*, of traumatic etiology, is the underlying pathology.

Of the *venous sinuses*, injury to the superior longitudinal sinus occurs with greatest frequency. It results from penetrating and non-penetrating (depressed fracture) injuries of the vertex of the skull. It may be inferred from the location of the injury, the direction of penetration and by direct recognition in open wounds. The lateral sinus may be injured in fractures of the middle fossa, and the cavernous sinus in fractures through the sphenoid bone.

Sinus Thrombosis.—Any of the venous sinuses within the skull may be injured. In penetrating wounds, this may be inferred from the location of the wound and the apparent direction of the missile. The superior longitudinal sinus is most often injured in this manner. Laceration and division cause hemorrhage. Minor lacerations and contusions, often associated with fractured skull, may result in thrombosis. The local symptoms produced depend upon the sinus affected.

Thrombosis of the *superior longitudinal sinus* is distinguished by edema of the forehead, distention of the overlying veins and repeated nosebleeds.

Thrombosis of the *lateral sinus* is accompanied by edema of the mastoid region. At times, the internal jugular is thrombosed, also, and can be felt as a firm cord-like structure in the neck. The veins of the opposite side of the neck are distended, particularly during inspiration. Spasm of the trapezius and sternomastoid muscles often occurs.

Thrombosis of the *cavernous sinus* is accompanied by intense chemosis of the conjunctiva, with swelling of the eyelids, and by exophthalmos. These signs may be either unilateral or bilateral. The cornea appears hazy, and the retinal veins are engorged. Sometimes, there is choked disk. The proximity of the third and sixth cranial nerves subjects them to pressure, and may result in palsy of the ocular muscles. Strabismus and ptosis are the usual signs of this affection.

Cranial Nerve Injuries.—The first, or *olfactory nerve*, is most often injured in association with fractures of the cribriform plate of the ethmoid bone. Like the other nerves at the base of the brain it is not uncommonly compressed, but much less often than the nerves in the middle fossa of the skull. Complete division causes loss of the sense of smell. Accompanying this there is also impairment of the sense of taste, since loss of smell abolishes the recognition of flavors as well.

The second, or *optic nerve*, is uncommonly injured. Penetrating objects, especially those entering through the orbit, are the principal cause. The nerve may be lacerated in fractures of the anterior fossa and orbit, or may be compressed in hemorrhage at the base of the skull. The result of serious injury is blindness. This is not always total, however, its extent depending upon the site of injury. In front of the optic chiasm, division causes total blindness in one eye. Behind the chiasm, before the fibers have decussated, vision is lost in the same fields of both eyes—the left halves of the retinae, for example, in division of the left optic nerve.

The third, or *oculomotor nerve*, supplies all of the extrinsic muscles of the eyeball with the exception of the superior oblique and the external rectus. In complete lesions, which are unusual, the eyeball is deviated outward and upward, and

Symptom	Thrombosis (in General)	Lateral Sinus
Onset	Gradual.	Gradual, with headache.
Consciousness	Not impaired until late in disease.	Not altered.
Convulsions	None unless cerebral edema ensues with focal symptoms.	None unless cerebral edema ensues with focal symptoms.
Associated symptoms ..	According to sinus affected.	Dyspnea and dysphagia; often hoarseness from cranial nerve pressure.
Pulse	Rapid, varying with temperature.	Rapid, varying with temperature. May be slow due to vagus nerve pressure.
Temperature	Septic type, often associated with chills and sweating.	Septic type, often associated with chills and sweating.
Ocular signs	Involved in thrombosis of cavernous sinus.	Unchanged.
Cranial nerves	According to cranial nerve involvement.	Pressure effects on ninth, tenth, eleventh, and twelfth cranial nerves.
Blood-pressure	Normal or subnormal.	Normal or subnormal.
Spinal fluid	Negative.	Negative.
Course and special data	Fairly rapid. Septic or pyemic type, often associated with enlarged spleen, and skin, lung and bone metastases. Severe headache, over particular sinus or in occipital region, or deep-seated ocular pain.	Fairly rapid. Septic or pyemic type, often associated with enlarged spleen; skin, lung and bone metastases. Severe headache, over particular sinus or in occipital region, or deep-seated ocular pain. Edema over mastoid region and dilatation of jugular vein on affected side, are highly significant. Latter often indurated and cordlike.

motions in other directions are lost. Incomplete lesions may affect any of the muscles supplied. The paralysis is painless. Ptosis is usually present, and loss of accommodation reflex of the pupil. The pupil is dilated in paralytic injuries; contracted in irritative lesions.

The fourth, or *trochlear nerve*, supplies the superior oblique muscle of the eyeball. It is rarely injured. The result is weakness or absence of function of the trochlear muscle, indicated by inability to move the globe downward and outward.

The fifth, or *trigeminal nerve*, has three branches. The upper two, the supra-orbital and maxillary branches, are purely sensory, supplying the skin of the forehead, part of the scalp, the greater portion of the face, the conjunctiva and the teeth of the upper jaw. The lowest, or mandibular branch, is both motor and

CRANIAL SINUS THROMBOSIS

Cavernous Sinus	Longitudinal Sinus	Symptom
Gradual, with headache, deep ocular pain or severe supra-orbital neuralgia.	Gradual, with headache.	 Onset
Not altered.	Not altered.	 Consciousness
None unless cerebral edema ensues with focal symptoms.	None unless cerebral edema ensues with focal symptoms.	 Convulsions
Palsy of motor nerves of eyeball—third, fourth and sixth cranials.	Not observed.	.. Associated symptoms
Varies with temperature.	Varies with temperature.	 Pulse
Septic type, often associated with chills and sweating.	Septic type, often associated with chills and sweating.	 Temperature
Exophthalmos on affected side. Edema of lids, conjunctiva. Palsy of motor nerves. Retinal hemorrhage. Optic neuritis or choked disk.	Not affected.	 Ocular signs
Ocular reflexes impaired or absent.	Not affected.	 Cranial nerves
Normal or subnormal.	Normal or subnormal.	 Blood-pressure
Negative.	Negative.	 Spinal fluid
Fairly rapid. Septic or pyemic type, often associated with enlarged spleen, and skin, lung and bone metastases. Severe headache, over particular sinus or in occipital region, or deep-seated ocular pain. Edema of lids, conjunctiva and forehead, and exophthalmos are distinctive features.	Edema of forehead, bridge of nose, or scalp. Occasionally, nosebleed.	Course and special data

sensory, supplying the skin over the lower jaw, the teeth and the muscles of mastication. Irritative lesions cause pain of a neuralgic type, often extremely severe, in the domain of one or more branches. Trismus may also result. Destructive lesions cause palsy of the masticatory muscles, and anesthesia of the face and conjunctiva. The latter is frequently the basis of ulcerations of the cornea. An interesting accompaniment of lesions of the ganglion is herpes facialis, or herpes ophthalmicus.

The sixth, or *abducens nerve*, supplies the external rectus muscle of the eyeball. Paralytic lesions result in internal strabismus, with inability to roll the eyeball outward. Double vision is complained of because of the strabismus. This is often first noticed when descending stairs.

The seventh, or *facial nerve*, supplies motor fibers to the facial muscles, exclud-

ing those of mastication and, through its chorda tympani branch, is concerned with the special sense of taste. It also supplies the stapedius muscle. Facial nerve injury and compression rank next to similar conditions of the auditory nerve in frequency. In complete lesions, there is unilateral facial palsy, loss of taste in the anterior two-thirds of the tongue, and stapedius paralysis with buzzing and ringing noises in the ear. Because of the palsy of the muscles of expression, the affected side of the face appears smooth, with lessening or obliteration of the nasolabial folds and the facial wrinkles, and drawing of the angle of the mouth to the opposite side. The eyelids cannot be closed, the eyeball rolling upward and outward upon attempts to do so (*Bell's sign*); the brow cannot be wrinkled, and the cheeks cannot be blown out. Whistling is impossible. Emotions exaggerate the facial asymmetry. Failure to close the eyelids allows the lacrimal secretions to flow over the face, and exposure of the cornea may result in ulceration. Difficulties in speech and chewing of food are common.

Depending upon the level of the nerve injury, the stapedius may escape, or taste may be preserved. In peripheral injuries, both of these functions are intact. The seventh and eighth nerves are frequently injured at the same time.

The eighth cranial nerve, the *auditory nerve*, is injured more often than any of the cranial nerves, this taking place in association particularly with fractures of the temporal bone at the base of the skull. Two symptoms result from such injuries—deafness from involvement of the auditory division of the nerve, and vertigo from involvement of the vestibular division.

The ninth, or *glossopharyngeal nerve*, supplies the muscles of the soft palate, pharynx and tongue, the former through the pharyngeal plexus, to which the vagus and spinal accessory nerve send fibers. It also is the nerve of taste in the posterior third of the tongue. The ninth to the twelfth cranial nerves are rarely individually injured. The most common lesion is a medullary one, involving two or more of the nerves.

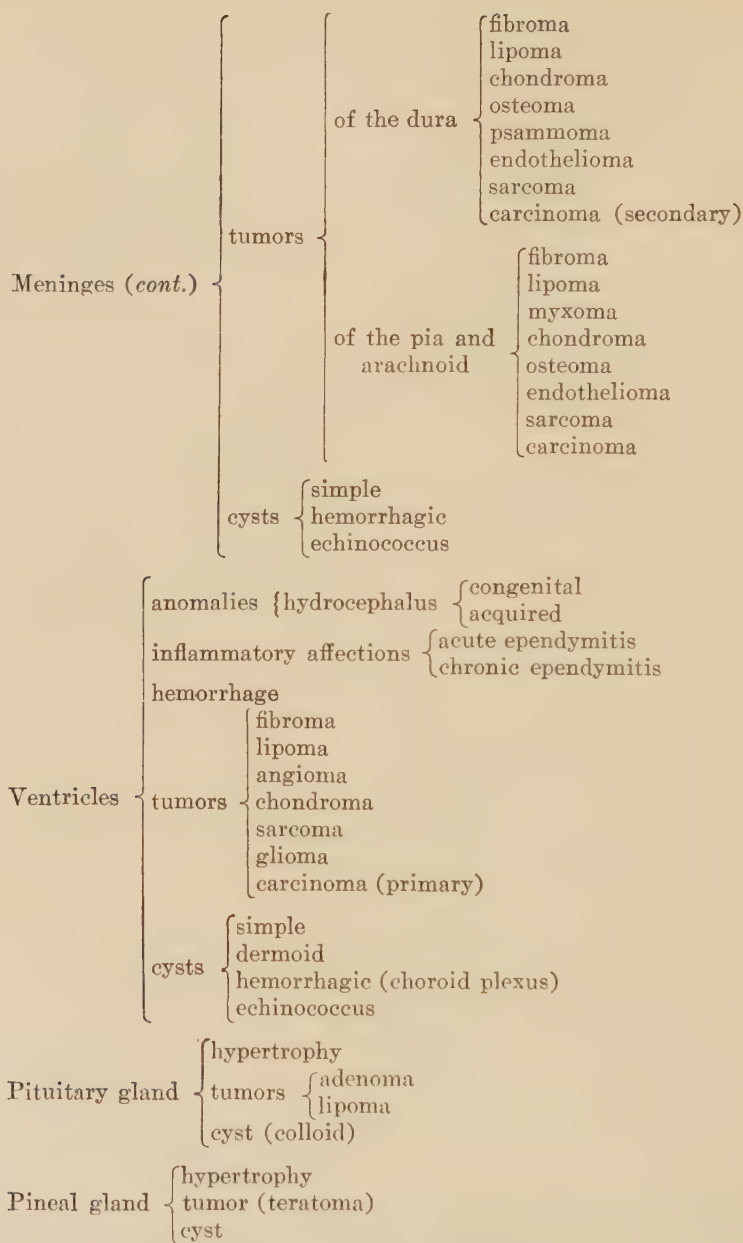
The tenth, or *vagus nerve*, supplies sensory fibers to the external auditory canal; motor fibers to the pharyngeal plexus and the laryngeal muscles (recurrent laryngeal branch); regulatory, or inhibitory fibers to the heart; fibers to the stomach; and communicates with the abdominal sympathetic fibers. Paralytic lesions affect the pharynx and larynx, causing dysphagia, dysphonia or aphonia. The cardiac action may or may not be accelerated, since the heart has bilateral innervation. Sudden death is sometimes caused by medullary involvement of the nuclei of origin.

The eleventh, or *spinal accessory nerve*, through fibers which accompany the vagus nerve, enters into the pharyngeal plexus, supplying the constrictor muscles of the pharynx. The main trunk supplies motor fibers to the sternomastoid and trapezius muscles. Irritative lesions produce *spasmodic torticollis*; paralytic lesions prevent function of these neck muscles with inability to rotate the head toward, and elevate the shoulder on, the affected side. Unopposed action of the sternomastoid of the opposite side causes torticollis or wry-neck.

The twelfth, or *hypoglossal nerve*, is rarely affected. Few cases have been reported. It is usually accompanied by some injury to the ninth, tenth and eleventh nerves. The symptoms include difficulty in deglutition, affection of the speech and tongue atrophy.

AFFECTIONS OF THE BRAIN AND MENINGES

Brain	{	malformations and anomalies	{	anencephaly
			microcephaly	
			cyclopia	
			porencephaly	
			cephalocele	
			hydrocephalus	
			hypertrophy and atrophy	
		injuries		
		inflammatory affections	{	acute encephalitis
			chronic encephalitis	
	abscess			
circulatory affections	{	hemorrhage		
		thrombosis		
		embolism		
		aneurysm		
		vascular spasm		
		apoplectiform seizures		
		venous sinus thrombosis		
		granulomata	{	syphilis
tuberculosis				
actinomycosis				
epilepsy				
cerebral localization				
tumors	{	glioma		
		neuroglioma ganglionare		
		endothelioma		
		sarcoma		
		carcinoma		
		fibroma		
		papilloma		
		angioma		
		cholesteatoma		
		myxoma		
		osteoma		
Meninges	{	injuries (see "Cerebral Injuries")		
		inflammation	{	acute meningitis
				primary epidemic (meningococcal)
				secondary
				chronic meningitis
				pachymeningitis
		abscess	{	extradural
				subdural
circulatory affections	{	hemorrhage		
		thrombosis		
		hematoma		
granulomata	{	syphilis		
		tuberculosis		
		actinomycosis		



Malformations and Anomalies

Most of the congenital alterations in the size and shape of the brain have but little surgical interest. They occur in conjunction with changes in the skull, the brain development corresponding in conformation therewith.

In *anencephaly*, the brain is practically absent. Only the base of the skull is present, sloping sharply backward from glabella to occiput.

Microcephaly denotes a brain of diminutive size. The more marked instances of microcephaly are frequently associated with idiocy and imbecility.

Cyclopia.—In this conjunction the eyes are fused and situated in the middle of the forehead. But one optic nerve is present.

Porencephaly.—Under this title are embraced several pathologic affections of the brain, characterized by motor paralysis, and giving rise to the condition known as *cerebral palsy of childhood*. Pathologically, in porencephaly there is a large or small brain defect, represented by an oval or rounded cavity. Other changes include meningo-encephalitis, sclerosis of the brain and softening. Clinically, symptoms appear at birth or develop within the period of infancy or very early childhood and consist of unilateral or bilateral hemiplegia, with rigidity and increased tendon reflexes. The onset, sometimes, is marked by one or more convulsions and fever. Instead of hemiplegia, there may be paraplegia. In diplegia, the child is helpless. In those able to walk, the gait is spastic, sometimes scissors-like. Contractures are common. Choreiform movements are often to be noted and the mentality is frequently affected, sometimes with speech disorders. The primary form is congenital, while the secondary type of porencephaly is due to injury interfering with the blood supply.

Injuries during delivery of the child and in infancy, and inherited syphilis are the chief etiologic factors. The paraplegic form is called *Little's disease*.

Cephalocele.—Herniæ of the brain and meninges occur as congenital anomalies. They are similar anatomically to like affections of the spine. Thus, there are meningocele, meningo-encephalocele and encephalocystocele, according to the components of the sac. The occipital region is the most common site. The protrusion, however, may be through the frontal region, in or to the side of the orbit, or appearing in the nose or pharynx. The cephaloceles of the occiput and vertex are in the midline, sometimes emanating through the posterior fontanel. The mass appears rounded, as a rule, but may be pedunculated. The size is usually small but may equal that of the infant's head. In the larger varieties, the skin is often translucent; in the smaller herniæ, the skin is of normal appearance, or may show blood-vessel dilatation, superficial thickening and angiomatous changes. The mass is tense or fluctuant. It becomes more firm upon crying and straining efforts. Sometimes, there is visible pulsation. Some are partially reducible, allowing palpation of the defect in the skull. Attempts at reduction accelerate the pulse and may induce convulsive seizures. The overlying skin may become ulcerated, leading to secondary infection and meningitis.

Acquired brain herniæ follow operations for the relief of increased intracranial tension in connection with brain tumors. The convolutions of the brain, usually greatly engorged, bulge through the operative bony defect. The hernia increases greatly in time and the brain is subject to the dangers of secondary infection and hemorrhage.

Hydrocephalus.—This occurs as a congenital or primary disease in infants and children, and as a secondary affection in adults and children. Factors in the *congenital* form include injury, spina bifida and syphilitic infection; in the *acquired* form, syphilis, sinus thrombosis, chronic meningitis, abscess and tumors of the brain. The affection is characterized by a great increase in the amount of cerebrospinal fluid. The hydrocephalus may be chiefly within the membranes of the brain (external hydrocephalus), or the ventricles may be enormously dilated (internal hydrocephalus).

In the congenital form, mild degrees are indicated merely by abnormal enlargement of the head. The unusual size is not strictly congenital, as a rule, but develops within the first few months of life. As a consequence, the fontanels are bulging, the eyes are prominent and the face appears small. In marked hydrocephalus, the head becomes huge. Convulsions and vomiting are common, and palsy of the eye muscles may develop. Nystagmus is frequent, and there is often paralysis or rigidity of the extremities, particularly the lower, and of the posterior cervical muscles. Hydrocephalus is chronic in course, and often is accompanied by mental deficiency. The spinal fluid shows lymphocytosis.

The acquired form may be acute in onset and course but, more frequently, is chronic. Acquired hydrocephalus develops after acute meningitis or in the course of chronic meningitis, or appears in conjunction with cerebral tumors, abscesses and sinus thromboses. All of these processes act by *obstruction* of the *foramen of Magendie*, or by *occlusion* of the *vena magna of Galeni*. The bony sutures having united, enlargement of the head does not take place. Otherwise, the general symptoms are similar to those of the congenital form—headache, vomiting and convulsions. Optic atrophy is more common, and various cranial nerve palsies, excluding the eighth nerve, occur. Hemianopsia is frequent. Weakness of the lower extremities, spasms of the leg muscles and cerebellar ataxia are frequently observed. Choked disk sometimes occurs prior to optic atrophy.

Hypertrophy and Atrophy.—True hypertrophy, or cerebral enlargement, occurs in certain individuals without any particular explanation. In general, the size of the brain has no bearing upon the mental capacity.

Atrophy is the result of various pressure states: Inflammation, degenerative changes and senility. Some of these occur congenitally or develop in early childhood; for example, the porencephalies and hydrocephalus. Others appear in later life, the sequel of meningo-encephalitis, endarteritis obliterans, thrombosis, cysts, tumors and abscesses. Atrophy may, therefore, be localized or generalized. Atrophy is especially marked in general paresis. Atrophic brains may be associated with mental changes, and defective development—idiocy and imbecility. There may be no impairment of the mentality.

Injuries

(See pages 50, 58-61.)

Inflammatory Affections

Acute Encephalitis.—This condition is also known as lethargic encephalitis, and frequently misnamed “sleeping-sickness”; encephalitis occurs in two anatomical locations, which are distinguished as “superior” and “inferior” forms. *Superior polioencephalitis* affects, in particular, the oculomotor nerve nucleus, and sometimes those of the fourth and sixth cranial nerves. The disease affects adults chiefly. It is characterized by sudden or subacute onset, with somnolence or coma, and palsy of the extrinsic muscles of the eyes. The palsy is usually bilateral, but asymmetrical, and the intrinsic ocular muscles are not implicated. The pupillary reactions are thus preserved. Fever may be present, but is low; the pulse, however, is usually increased; cerebellar gait, ataxia and hemiplegia may

result; the latter is not associated with sensory disturbances. At times, the medullary centers are involved.

Inferior polioencephalitis affects the medulla. The general symptoms are similar. The local symptoms result from implication of the nuclei of origin of the ninth to twelfth cranial nerves. The onset is usually very acute with vertigo and rapidly following unconsciousness. Difficulty in speech and swallowing, change in the voice, and cardiorespiratory disturbances occur. The temperature is often elevated. Hemiplegia, or paraplegia, may develop with abolition of reflexes and sensory losses or perversion. This form of encephalitis may be inflammatory, syphilitic or thrombotic. It may also be found in association with aneurysm and tumors.

Acute encephalitis may be caused by penetrating wounds, and may be associated with meningeal and skull infections, abscess of the brain, cerebral contusions and lacerations. Reactive encephalitis takes place in conjunction with foreign bodies, and develops about cysts, tumors and hemorrhages. Infective forms may also result from septic thrombosis.

Chronic Encephalitis.—Chronic forms of encephalitis, corresponding to the acute superior and inferior types, develop in association with arteriosclerosis, multiple thrombosis, syphilis, amyotrophic lateral sclerosis of the cord and syringomyelia. In the inferior, or *bulbar form*, atrophy of the affected glossopharyngeal muscles may be observed. The superior form is called *progressive ophthalmoplegia*, and involves either the extrinsic or intrinsic ocular muscles. Occasionally, both muscular groups are implicated. Chronic encephalitis is also associated with chronic forms of meningitis. The most frequent cause of this is syphilis. Advanced stages of meningo-encephalitis are characterized by atrophy of the convolutions, widening of the sulci and sclerosis of the cerebral tissues. The clinical symptoms depend entirely upon the part of the brain affected. There is frequently a similar process in the cord and its membranes, as in taboparesis and multiple sclerosis.

Cerebral Abscess.—Abscess of the brain results from closed injuries of the brain, at times, but more particularly from open wounds with secondary infections, from infections of the cranial bones and the various sinuses, and from general infectious diseases such as pneumonia, typhoid fever, endocarditis and pyemia. Following brain laceration or other injury, there is usually a latent period, the symptoms of abscess developing only after weeks, months or even years. Mastoiditis is a very frequent source. Abscess is often preceded by infections of the cerebral sinuses from this or other sources. Most abscesses occur in the cerebrum and, following this, in the cerebellum.

The general symptoms include headache, vertigo and vomiting, fever, leukocytosis, optic neuritis and mental lethargy. Headache is often referred to the site of scalp injury, sometimes with increased tenderness there upon pressure and percussion. Often it is generalized, however, and may be constant or intermittent, and is usually quite severe in intensity. Vertigo is apparent even upon change of position of the head in some instances, and such movements may precipitate attacks of vomiting. Vomiting is sometimes projectile, and is independent of the ingestion of food. Fever is not usually high and is not always present. Polymorphonuclear increase is practically constant, whether the total white blood-count is increased or normal. Tendency to somnolence and drowsiness, with lack of

attention and concentration, can usually be observed. In open wounds, drainage may be purulent. Complications of abscess include epileptiform and apoplectiform attacks; diffuse septic meningitis and rupture into the ventricular system.

The local symptoms depend upon the location. No definite symptoms may develop. Some abscesses appear, clinically, like cerebral tumor. The diagnosis depends upon the preceding and present history, the intermittent fever and the white blood-cell determinations.

Circulatory Affections

Vascular Lesions.—Affections of the blood-vessels play an important part in the production of neurologic diseases. Cerebral anemia is the controlling factor in some instances, such as in the brain injuries, and is induced not only by the trauma, but also by stasis and edema. New growths and abscesses also frequently produce cerebral anemia, by direct pressure on vessels, by means of reactionary edema and by obstruction of the ventricles with secondary hydrocephalus. In acute and chronic congestive states of the brain and meninges, the blood-vessels are always affected, sometimes functionally, at other times pathologically. In old age, the cerebral vessels often share the sclerotic changes which affect other parts of the vascular system. Endarteritis of toxic and chronic infective origins is also common, occurring in such conditions as nephritis, diabetes, syphilis, tuberculosis, chronic alcoholism and chronic lead poisoning. The arterial changes not only alter the blood supply of the brain; they also are paramount in the production of cerebral hemorrhages and thrombosis, as well as in functional disorders, such as vascular spasm.

Petechial hemorrhages within the brain occur frequently in association with brain injuries. They may be found in small areas, or diffused throughout a large part of the brain. Localizing symptoms are not produced, but this type of bleeding is important in the general picture, and contributes to the reactionary cerebral edema which is a constant pathologic accompaniment. Capillary hemorrhages may also take place in some of the blood disorders; in septicemia; after convulsions; in conjunction with endarteritis; and in the "wet brains" of uremic and alcoholic subjects.

Cerebral Hemorrhage (*Apoplexy*).—This is an affection of advanced life, although it sometimes occurs during middle age. The underlying cause is sclerosis and obliterating endarteritis of the cerebral arteries, induced by advancing old age, or by chronic systemic diseases and intoxications, such as nephritis, diabetes, syphilis, lead, alcohol and gout.

The onset is sudden. The patient becomes immediately unconscious, usually in a state of coma, with abolition of all reflexes, including the organics. The pupils are dilated, the face flushed, the respirations stertorous, and either regular or irregular. Facial asymmetry may be indicated by unequal distention of the cheeks during respirations, and by obliteration of the normal folds on one side. The pulse is slow, full, usually regular, and the blood-pressure is elevated. There is often a rise in temperature.

If coma is incomplete or as it recedes paralysis may be observed. Since the majority of cerebral hemorrhages takes place in the internal capsule, the paralysis is an hemiplegia, flaccid and contralateral in type. Lacking coöperation of the

patient, this may be appreciated by the difference in muscular tone; the manner in which a lifted extremity drops; an everted position of the foot, with outward rotation of the extremity; the absence of the tendon reflexes and the positive Babinski reflex. In later stages, the paralysis is spastic, with increased reflexes and contractures, particularly in the upper extremity. Some improvement takes place in favorable cases, the arm being the last to improve, however, and restitution rarely being complete. Dysarthria is frequent and there may be emotional disturbances.

There is a form of tardy or delayed apoplexy, which is gradual in onset and slow in development. This is the exception, however.

Cerebral Thrombosis.—Thrombosis of the cerebral arteries occurs in earlier age groups than hemorrhage, as a rule. Gradual obliteration of the end arteries of the brain, dependent upon similar factors, leads to thrombosis. Lowered blood-pressure states are additional factors. The onset in most cases is less abrupt than in hemorrhage, and is frequently preceded by paresthesiæ, or pain in an extremity. These sometimes exist for several minutes, or hours, or even days, before complete thrombosis. Transitory paralysis and aphasia may precede thrombosis. Other prodromata include headache and vertigo. There may also be changes in mentality. The attack itself is less acute than in hemorrhage; coma may not develop; and paralysis usually clears up rapidly. Mental and emotional disturbances are very common after-effects.

Cerebral Embolism.—Embolism of the brain occurs mostly in younger people (twenty to fifty years). In most instances there is a demonstrable cause, such as endocarditis, thromboses in pelvis, lungs or extremities, acute infectious diseases or arterial changes. The onset is abrupt, without prodromata, and is characterized by sudden loss of consciousness, often accompanied by convulsions or local spasms. As in thrombosis, coma is of short duration, and paralysis is not as complete as in hemorrhage. Paralysis, too, may be temporary or permanent. The condition is quite frequently encountered.

Aneurysm.—Aneurysmal dilatations are said to precede many instances of apoplexy. A dissecting aneurysm of an intra- or extra-cerebral vessel may be caused by trauma, and is a source of delayed hemorrhage. A dissecting aneurysm may also arise in conjunction with arterial changes, accounting for the rare cases of cerebral apoplexy which are gradual in onset and slow in progression.

Intracranial aneurysm, involving the larger vessels at the base of the brain, is probably more common than is ordinarily realized. The basilar, internal carotid, middle or posterior cerebral arteries and the circle of Willis may be involved. In some individuals, headache and a full feeling in the head are interpreted as signs of arterial hypertension, which the patient has, of course. In others, vertigo, vomiting, cerebellar ataxia and changes in the optic disks combine to simulate cerebral tumor. Various cranial nerves at the base of the brain may be compressed, or localizing cortical symptoms may develop. The latter, however, are not common. Very rarely a murmur is heard upon auscultation over the skull. As a rule the diagnosis is not made.

Vascular Spasm.—An acute cerebral anemia, induced by sudden spasm in one of the arteries of the brain, is not uncommon. Such spasm occurs, of course, in vessels previously thickened or sclerosed, and is often a precursor of a more serious

vascular lesion, such as hemorrhage. Vascular spasm is characterized by sudden and transitory disturbances. For example, a sudden aphasia which rapidly disappears; or temporary loss of consciousness, with or without palsy, which soon clears up. Spasm is particularly frequent in the presence of syphilitic endarteritis. Migraine is also due to vascular spasm.

Apoplectiform Seizures.—Attacks which resemble true apoplexy sometimes occur in the presence of cerebral abscess and cerebral tumors. In many instances they are due to hemorrhage, and, if important structures are involved, may result in permanent paralysis. In other cases, they are the result of edema and pressure on vessels. When a decrease of such symptoms takes place, or when hemorrhage is absorbed, there is restitution of the paralytic affections. Sometimes, only a special function, such as speech, is affected; or there is sudden unconsciousness without localizing symptoms. Apoplectiform seizures are frequently misinterpreted as being due entirely to vascular changes, but the possibility of new growths should always be considered, especially when the seizures are not consistent with the usual features of the true vascular lesions.

Venous sinus thrombosis has been considered under "Brain Injuries." Other causes include otitis media, principally in relation with the lateral sinus; infections of the nasal accessory sinuses; infections about the scalp, the upper neck, the skull and meninges; conditions accompanied by low blood-pressure, such as chlorosis, the anemias, myocarditis and wasting diseases; and, general diseases, such as typhoid fever, pneumonia and septic infections.

The symptomatology is not always definite, particularly since meningitis frequently precedes thrombosis, and gives rise to similar symptoms. The onset, therefore, is either gradual or sudden. An initial chill is frequent, with high temperature, headache and vomiting. Retraction of the neck, muscular twitchings and convulsions as in meningitis, often occur. There may be changes in the optic disks, and mental lethargy and somnolence, at times leading to coma, are frequently observed. Local symptoms vary with the particular sinus affected.

Granulomata

Syphilis.—This disease is a common invader of the brain and meninges. Syphilitic lesions, as *gumma*, are frequent and produce the symptoms of cerebral tumor. *Chronic meningitis* and *meningo-encephalitis* also are common; the changes in the frontal and prefrontal lobes in paresis are well known. Cerebral softening on the one hand, and sclerosis on the other, are frequently attributable to syphilis. The meningeal and cerebral blood-vessels are particularly affected in syphilis, forming the basis for many of the minor vascular disturbances, such as spasm, and also for the major lesions, such as thrombosis and hemorrhage. Syphilis also is the cause of many neurologic affections, such as epilepsy, multiple sclerosis, bulbar palsy and many others. It also accounts for a great many isolated disturbances, such as ptosis of the upper eyelid, pupillary changes and deafness, these being caused by involvement of the cranial nerves. Then, too, it is the basis for multiple symptoms of a general nature which are often diagnosed as neurasthenia. In short, it must be suspected in practically all affections of the brain and meninges, excluding the acute inflammatory processes.

Tuberculosis.—This is also a common disease of the brain and meninges. It may appear as an acute or *subacute meningitis*, as an *hyperacute miliary* form or as a *solitary tubercle* of the brain. The latter is very frequent and causes symptoms of cerebral tumor. Tuberculosis of the nervous system is either primary or secondary. Children and young adults are chiefly affected. The toxins of chronic tuberculous processes often affect the cerebral vessels, contributing to chronic impoverishment of the brain, and to arterial and sinus thrombosis. Both tuberculous and syphilitic tumors are subject to degeneration and secondary infections. Cerebral tuberculosis, of course, may become disseminated.

Actinomycosis.—This also affects the brain and meninges, in a chronic process which simulates the other granulomata. It is usually secondary. The symptoms may be general, local or identical with those of cerebral tumor.

Epilepsy

This is a common affection of the nervous system, occurring in two principal forms, the *symptomatic* and the *idiopathic*. Symptomatic epilepsy is of greater surgical interest, because it is a definite sign of cortical irritation and may be cured or relieved by surgical measures.

Symptomatic or *jacksonian* epilepsy is characterized by local spasm; that is, in a part or extremity which may or may not have been previously paralyzed. It may be confined to the original area, or it may spread to another extremity, or become generalized. When bilateral, consciousness may be lost; otherwise it is usually unaffected. Attacks of jacksonian epilepsy always begin in the same location, and, if spreading, always involve other parts in the same progression. No aura is present, as a rule. Local weakness may follow the attack. This form of epilepsy indicates an irritative lesion of the motor cortex, such as hemorrhage, tumor, apoplectic cyst, scar tissue or a depressed spicule of bone. It frequently follows cerebral injuries, particularly unrelieved, depressed fractures of the vault.

Idiopathic epilepsy occurs without gross cerebral lesions of distinction. Various factors enter into its etiology, and physical excesses, auto-intoxication, chronic disease and metallic poisonings, alcoholism, syphilis and emotions may contribute to its occurrence. The particular attack is often preceded by an aura, which may be sensory or motor in type, and may be referred to the special senses or may be purely psychic in nature. In the major forms (*grand mal*), the patient becomes immediately unconscious, with a generalized tonic convulsion, which involves the entire body and includes the respiratory muscles. After a brief interval, the convulsion becomes clonic, or intermittent, allowing stertorous breathing. The patient foams at the mouth, and involuntary urination and defecation are common. During the attack the patient frequently bites his tongue, the pupils are wide and immobile, and there is a Babinski reflex. Following the attack, there is amnesia and a pronounced tendency to somnolence. Unconsciousness may be the only symptom of epilepsy.

Lesser forms of epilepsy (*petit mal*) also occur. In these, there is usually no aura, and consciousness may not be affected. When unconsciousness is present, it is transient, and is followed by amnesia. In some, there is merely a fixed attitude, a staring expression or the sudden interruption of an act or speech, usually with

vertigo and facial pallor. Following the attack, there is a tendency to action, sometimes violent.

Epilepsy is sometimes accompanied by mental deterioration or insanity, and a persistent epileptic state sometimes ensues.

Localization of Affections

In considering this subject, the surgeon cannot be limited to conditions which are strictly of surgical nature, but must include numerous affections which belong essentially to the internist or neurologist. In order to make satisfactory differential diagnoses, and to properly identify surgical diseases, his knowledge must embrace fields other than his own. Also, this knowledge must include comprehensive anatomic and physiologic facts relative to the brain and meninges, so that clinical findings may be correlated, and interpreted in respect to brain areas which are suspected of being involved.

This problem of localization is a complicated one. Anatomically, the gross divisions are apparent. Many of the finer, microscopic details, especially the association fibers, are not so evident. Physiologically, certain brain areas are known to control definite functions—sensory, motor, special senses, reflex and vital functions. A large part of the brain, nevertheless, is uncharted. This lack of definition pertains in particular to the psychic functions. Thus, there are the “silent” regions of the brain, where even extensive disease processes occasion no symptoms which can be utilized as aids in localization. Also, the relatively long course of many of the central neurons, from cerebral cortex to spinal cord or peripheral distribution, allows dysfunction at various points. It is also important to recognize that lesions of the brain can be either irritative or paralytic, thus giving rise to two diverse types of symptoms.

The following anatomicophysiology facts will be of service in cerebral localization:

The Motor Area.—This is located in the cortex of the frontal lobe, in the ascending frontal, first, second and third frontal lobules, and the operculum and paracentral lobule. It thus includes portions of both the lateral and mesial surfaces of the frontal lobe. Acts, rather than particular muscles, are represented, so that muscle representation is essentially multiple. From above, downward, are the leg, arm and face areas, with smaller centers for the movement of various parts, such as the fingers and toes. For the most part, the cerebral cortex of the motor area controls the opposite side of the body; muscles which have bilateral innervation are represented in both hemispheres, however. This includes those supplied by the upper fibers of the facial nerve. The center for the trunk muscles is in the base of the first or superior frontal convolution; and that for conjugate deviation of the head and eyeballs to the opposite side is in the base of the second frontal.

The Sensory Area.—This is also placed in the cerebral cortex, in the post-central convolution of the parietal lobe. Like the motor region, its area of control is the opposite side of the body. Probably the superior parietal and the paracentral lobule are part of the sensory cortex, also. The sensory area is probably the site of memories of the finer tactile perceptions, and it is quite likely that pain, tem-

perature, pressure and muscle sense are not perceived here. Disturbances of this region result in paresthesia, hyperesthesia or anesthesia.

Speech Centers.—The motor speech center, Broca's area, is in the base of the left inferior frontal convolution. Destruction of this area does not affect the muscles involved in speaking, but inability to speak is due to the loss of memory of the act of speaking. In some instances, the patient can make sounds, or can say a few words; in minor affections, he may repeatedly select the wrong word, or "stumble" for words, particularly nouns. Loss of speech may be associated with inability to write (*agraphia*) since the two processes are related, as a person speaks words to himself when writing; and, also, since the two cortical areas for these acts are joined by means of communicating fibers. In addition, there may be some disturbance of reading. When the muscles of phonation are paralyzed, the patient has anarthria or dysarthria, rather than motor aphasia.

Writing Center.—This center is in the base of the second left frontal convolution in right-handed individuals, and its destruction causes agraphia, or inability to write, without paralysis.

Vision.—The cerebral center for visual perceptions is the area about the calcarine fissure, in the occipital lobe, including the cuneous and the lingual lobule. Irritative lesions sometimes produce visual hallucinations, in particular the scintillating scotoma. Paralytic lesions cause *homonymous hemianopsia*; for example, a lesion of the left visual area causes blindness of the right halves of the fields of vision. Smaller lesions, above or below the calcarine fissure, produce tetranopsia or loss of vision in quadrants of the visual fields. The lower quadrants are represented above the calcarine fissure in the occipital lobe of the opposite side; the upper quadrants below the fissure, also on the opposite side. Blindness from lesions of the cortex does not include the central vision, and does not abolish the pupillary reaction to light. *Hemiambyopia* and *hemichromatopsia* may precede hemianopsia.

Smell and Taste Centers.—The senses of smell and taste are represented in the temporal lobe, in the uncinate gyre and the hippocampus. These special senses may be diminished or lost or, in certain lesions, "uncinate fits" may occur. These consist of a sense of disagreeable odors, accompanied by transitory disturbance of consciousness.

The Frontal Lobe.—This contains the motor area, the centers for the acts of writing and speaking, and is the cerebral region in which the intellectual faculties reside. Ordinarily, the speech and writing centers are in the cortex of the left frontal lobe in right-handed individuals, and in the right frontal lobe in left-handed persons. Tumors and other lesions may attain large size in the prefrontal region, and yet produce no special symptoms. Usually, there are disturbances of memory, listlessness and alterations of temperament. The latter is very likely to be manifested by restlessness, irritability and lack of concentration. Agraphia and aphasia, if they develop, are of localizing value. The motor disturbances often take the form of awkwardness, lack of skill, or apraxia, but hemiplegia or monoplegia may appear. Monoplegia is typical of cortical involvement; it may develop slowly, and is flaccid at first, later becoming spastic, with increased reflexes. Paralysis is contralateral, of course. There may be paralysis of the trunk muscles, with subsequent contractions. Jacksonian epilepsy, localized to an extremity or part, or becoming generalized, is quite significant. Other symptoms which may present in

frontal lobe affections include conjugate deviation of the head and eyeballs to the opposite side; anosmia; amblyopia; exophthalmos; and optic atrophy. Cerebellar gait is not uncommon in tumors of the frontal lobe. The higher psychic functions are more developed on the left side of the brain.

The Parietal Lobe.—The parietal lobe presides over sensations, and is also concerned with vision and reading and the control of conjugate deviation of the head and eyeballs to the same side. Lesions may produce no symptoms; disturbances may only affect sensation; or motor symptoms may also be present, because of association fibers or mechanical effects upon the adjacent motor area or its projection fibers. In addition, there may be loss of muscle sense, apraxia and astereognosis on the opposite side of the body. These three symptoms, in the absence of motor weakness, indicate involvement of the parietal lobe. Conjugate deviation to the side of the lesion occurs and there may be hemianopsia and alexia.

The Occipital Lobe.—This lobe is concerned with the visual functions. As in other parts of the brain, there may be localizing symptoms. More frequently, there is alteration of vision. Incomplete lesions produce hemiamblyopia and hemichromatopsia. Complete lesions produce homonymous hemianopsia, or tetranopsia. Perversions of the sense of sight (visual hallucinations) sometimes occur, the most typical being a scintillating scotoma. Other possible developments in the left-sided lesions are optic aphasia, alexia and psychic blindness. Occipital lobe tumors, cysts, and abscesses may exert pressure upon the pons and cerebellum through the tentorium, and thus produce symptoms referable to those areas.

The Temporal Lobe.—As in other lobes, no particular symptoms may result. The temporal lobe presides over the special senses of taste and smell, either or both of which may be lost. Perversions of the sense of smell sometimes occur, as mentioned previously (uncinate fits). On the left side, lesions of the first temporal convolution and the adjoining supramarginal gyre cause sensory aphasia. In this, hearing is not affected, but the patient does not appreciate the meaning of spoken language and, in speaking himself, makes frequent mistakes and erroneous substitutions. Agraphia and alexia may be associated. Hemianopsia is occasionally found in connection with temporal lobe affections.

The Basal Ganglia.—Lesions here may produce hemiplegia, by pressure on the internal capsule. More suggestive are emotional disturbances, alteration of speech and intermittent incontinence of the bladder and rectum, especially the former. Elevation of temperature occurs, particularly in the involvement of the *caudate nucleus*.

Affections of the optic thalamus are also associated with indirect hemiplegia. Sensory losses are severe, and may be associated with pain. Hemianopsia may be observed, and choreiform movements and vasomotor disturbances sometimes occur in the paralyzed parts. Facial palsy, which is only evident during emotional stress, is fairly distinctive.

The Corpora Quadrigemina.—Lesions in this situation, along with involvement of adjacent structures (geniculate bodies and red nucleus), are indicated by amblyopia, oculomotor palsy, ataxia, tremor, deafness and vasomotor disturbances. Amblyopia from this source is accompanied by immobile and dilated pupil. The third nerve palsy is most significant when it embraces the same extrinsic muscles on both sides.

The Cerebellum.—The principal features of cerebellar lesions are vertigo and instability of standing posture and gait (*cerebellar ataxia*). There is a pronounced tendency to fall toward the side of the lesion. The gait may be reeling or uncertain, and often exhibits excessive and incoördinate movements, such as those which occur in tabetics. Flaccid paralysis is frequent on the side of the lesion, and an apparently spastic hemiplegia may be found on the opposite side. Affections of the fifth, sixth, seventh and eighth cranial nerves (homolateral) are common. Likewise, there may be tremor, nystagmus and speech disorder, as in multiple sclerosis.

The Pons and Medulla.—In these regions are located the nuclei of origin of many of the cranial nerves, including those which control the vital functions of respiration and the heartbeat. Affections of the pons and medulla produce alterations of these nerves, homolateral in type. In the pons, the most frequent finding is a crossed paralysis, the face altered on the same side, and arm and leg on the opposite side. The fifth and sixth cranial nerves are sometimes affected, while dysarthria and dysphagia are fairly common. Deafness and loss of conjugate movements of the eyeballs are characteristic. Ataxia, emotional and vasomotor disturbances sometimes result. Recurrent abolition of the knee-jerk and intermittent loss of control of the organic sphincters may be observed.

Medullary lesions are very similar to those of the pons, but the eighth to the twelfth cranial nerves are particularly affected. Also, alterations of speech, voice and deglutition are apt to be more complete than in pontine localizations, and vasomotor changes are more striking. Hiccough, respiratory paralysis, diabetes insipidus and Horner's syndrome may occur. When paralysis is associated, it may be unilateral or bilateral.

Tumors

Omitting gumma and the solitary tubercle, which produce symptoms of cerebral tumor, the most frequent true neoplasm of the brain is the glioma. This tumor may be of the usual type, or may be composed largely of oversize ganglion-cells—the neuroglioma ganglionare. Next in order of frequency is endothelioma; then sarcoma, carcinoma, fibroma, papilloma, angioma and cholesteatoma. The pathologically benign tumors—myxoma, fibroma, lipoma and osteoma—are rare.

About one-fourth of all cerebral tumors occur during the first twenty years of life; about one-fourth in each of the next two decades; and the remainder from forty to sixty-five years of age, being rare after the age of sixty. Also, the incidence gradually decreases after the age of forty. *Glioma*, especially, is found in children and early adult life, and the same is true of *sarcoma*. Cerebral tumors may occur singly, or two or more may coexist. *Carcinoma* is usually secondary; *sarcoma* is usually primary. Of contributory factors in the production of cerebral tumors, trauma is the only one which merits any attention, and it is extremely difficult to determine even this relationship in most instances. However, it must be admitted that trauma appears to act as an exciting cause of brain tumor, and that traumatic lesions sometimes precede the development of a tumor.

Anatomic locations are variable. Most cerebral tumors are subcortical, and are in one or more lobes of the cerebrum. *Cerebellar tumors* rank next in frequency; in infancy and childhood, the cerebellar location predominates. In third

place are tumors of the cerebral cortex, then of the basal ganglia, the corpora, pons and medulla. A particular series of brain tumors may depart considerably from this arrangement of frequency, of course. In the cerebrum, by far the greatest number of tumors arise in the frontal lobes. The frequency seems to diminish progressively in the lobes from the frontal region posteriorly. Pontine tumors are by no means infrequent, although tumors of the medulla are comparatively rare.

In studying the problem of cerebral tumors, the first clinical premise is that any abnormal collection of cells, any cystic accumulation or any unabsorbed extravasation constitutes, from the standpoints of effect and symptomatology, a brain tumor. On this basis, gumma occurs with greatest frequency and the tubercle also supersedes the neoplasm; while cysts of any origin, abscesses and hematomata become identical with neoplastic affections for purposes of discussion.

The second premise is that a brain tumor may exist without producing symptoms, either general or focal. Localizing symptoms are more likely to be absent than are general symptoms. We must also acknowledge that tumors of the brain are often associated with retrogression of clinical effects. Thus, the tumor itself may be advancing, but the patient shows clinical improvement. This is explained by alterations in compression of the blood-vessels with reduction of induced cerebral anemia; by changes in the extent of perifocal edema; and by absorption of hemorrhagic exudates—all of these factors being commonly associated with tumors.

The third essential premise is that every brain tumor, regardless of its pathologic character, is potentially malignant in the sense that it threatens functional usefulness, and also the life of the individual, if unrelieved. Thus, the fibroma of the brain, which produces symptoms and increases in size, is capable of the same dire results as the most infiltrative type of glioma or sarcoma. Proximity to important anatomic structures, indirect pressure effects and the pathologic complications of cerebral tumors before mentioned, when occurring in certain regions, are fully as important in both morbidity and mortality as is direct invasion by a malignant tumor.

The general symptoms of cerebral tumor are the result of increased intracranial tension. Direct pressure by the tumor with ventricular overdilatation may be the cause. Headache is usually present. It may be on one side of the head, or in a particular region, or generalized. In some instances it is unbearable in severity. Nausea and vomiting are two symptoms of value. The vomiting is often independent of the taking of food, and may be projectile in character. Change of posture of the head sometimes induces immediate vomiting. Vertigo is also common. Changes in temperament, memory and mental capacity are fairly frequent, but not constant. A very important sequel of brain tumor is change in the optic nerve head. In the early stages this consists of congestion of the vessels and blurring of the disk margins; in later stages, there is true choked disk with considerable elevation of the papilla. Progressive impairment of vision may, therefore, be one of the symptoms of brain tumor; yet, the central vision being preserved, the patient oftentimes is unaware of impaired vision; choked disk is usually bilateral, hence does not aid in localization.

Local symptoms and signs of tumor may be referable to any part of the brain. Embracing such a wide range, they afford a severe test of the examiner's

knowledge of nervous anatomy and physiology, and of his experience with neurologic disorders. Under "Cerebral Localization" some of the regional syndromes have been indicated. That a tumor may press or extend in any direction is apparent. That a cerebral tumor may exert pressure upon the tentorium and induce cerebellar symptoms should also be noted. Tumors within the lobes (subcortical), may involve various sets of fibers, resulting in a bizarre clinical problem which requires expert deciphering, or which may defy all efforts. Also, a tumor may be located in more than one lobe, or may invade parts of both hemispheres. Affections of the cranial nerves aid in localization. Central lesions of the nuclei of origin differ clinically from peripheral lesions of the nerves, in some instances; peripheral lesions can be interpreted as having arisen in a particular fossa of the skull and the tumor thus be located in the part of the brain anatomically adjacent. Loss of special functions which have cortical representation often will localize a tumor. Physical changes cause either general symptoms, or are very largely the sequel of frontal lobe tumor. Vision, reading and writing are really complex functions, and their disturbances must be very completely analyzed.

Progression characterizes most cerebral tumors. Recurrent irritative affections of the motor system—twitchings, convulsions, jacksonian epilepsy—are significant, especially when followed by any demonstrable weakness in a part. Paralysis is always suggestive but motor weakness, particularly when advancing, and unaccustomed awkwardness, should be just as significant. Monoplegia, or hemiplegia which later becomes a monoplegia, is typical of cortical disturbance; a frank hemiplegia is more suggestive of deeper lesions, especially about the internal capsule. In the cerebrum, motor and sensory symptoms are contralateral. In the pons, a crossed paralysis (hemiplegia on the opposite side, facial palsy on the same side) often occurs.

One should always be suspicious of convulsions and apoplectiform seizures without demonstrable cause; and of neurologic symptoms without logical basis.

AFFECTIONS OF THE FACE

Inflammations	{	erysipelas
		acute cellulitis
		furuncle
		carbuncle
		abscess

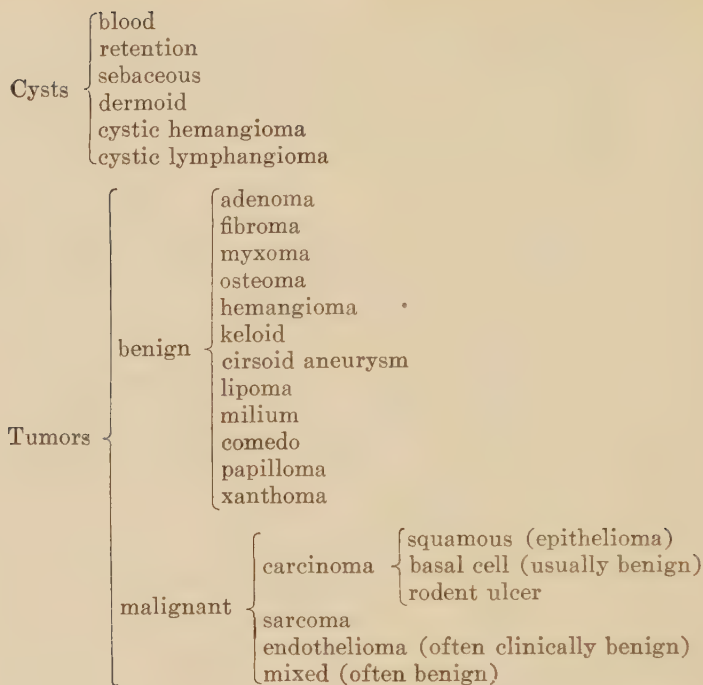
Noma

Granulomata	{	actinomycosis
		blastomycosis
		tuberculosis (including lupus)
		leprosy
		syphilis (primary, secondary, tertiary stages)
		glanders

Anthrax

Von Mikulicz's disease

Angioneurotic edema (not surgical)



Inflammations

Erysipelas, acute cellulitis, furuncle, carbuncle and pyogenic abscess are acute infections with all the positive signs of inflammation. See chapter on "Infections."

Noma

(*Gangrenous Stomatitis*)

This is a rapidly spreading disease of the mucous membrane of the cheek, extending through the buccal tissues and quickly invading the cutaneous surface. The lesion appears, first, as a purple discoloration or small ulcer on the mucosa. Gangrene of the soft tissues of the face and mouth is present and a severe state of toxemia ensues. Regional glands become enlarged. Pain is usually not present. It is found most especially in poorly nourished children under the age of seven. It occurs most commonly in institutions, following previous epidemics of measles, scarlet fever and other acute diseases.

Granulomata

Actinomycosis and blastomycosis are conditions which should be considered together, the process of the disease being similar in many respects, both being of a chronic course, with a tendency toward ulceration, infiltration and extension. Both are met with usually after the age of forty, though actinomycosis is occasionally found in the young adult. Occupation bears no incidence relation to blastomycosis, while farmers, grain handlers and the like, are prone to actinomycosis.

Actinomycosis appears as a nodular swelling especially about the cheek and jaw region, irregular in contour and fairly hard in consistency, with a tendency toward invading the surrounding tissues, which in turn become indurated and hard. Very often inflammatory signs will overlie an actinomycotic condition, giving rise to added symptoms of acute and chronic inflammation. As the disease advances to the ulcerative state, a solitary or communicating sinus develops, from which exudes a yellow, purulent material. The edges of the ulcer become irregular, hard and indurated. Regional lymph-gland involvement at times occurs. Actinomycotic granules are often found in the discharge. *Blastomycosis* usually starts as a purple pustule which soon breaks down and forms into a definite ulceration. The surface of this ulceration is more or less warty, and surrounding it is a blue red areola containing minute abscesses. The blastomycotic fungus is often found in the discharge.

Tuberculosis of the face may be divided into three definite groupings: (1) Anatomic tubercle; (2) lupus; (3) tuberculosis verrucosa.

The anatomic tubercle, which is rare and which is more frequently found in other locations of the body, is occasionally, however, encountered in the face region. It is characterized by an elevated, red, circumscribed nodule, painless and with a tendency toward subsequent ulceration with sinus formation.

Lupus is another type of tuberculosis and is characterized by a chronic, painless affection of the skin, beginning as a small, rather soft, brown yellow area, gradually breaking down. The course of the ulceration is quite characteristic of "serpiginous advancement," in that there is a tendency toward peripheral spreading, and central healing, and replacement by scar tissue. The disease is most commonly found on the nose, lip and forehead and occurs in early adult life or middle age. When situated over the bridge of the nose it may assume the "butterfly" appearance.

Tuberculosis Verrucosa.—The formation of patches showing an outer red border, a middle zone of pustules and a central area of papules is quite characteristic of this lesion.

Leprosy is so rare in this country that perhaps it should be considered from the standpoint only of a mention in the classification, but our acquisition of outlying countries, some of them situated directly within the leper zone, and its appearance in our seaport towns, makes it imperative for us to consider it briefly. Leprosy is a chronic disease found especially among the yellow races. The onset of the disease is characterized by diffuse, hypersensitive areas of erythema which are slightly elevated. As the disease progresses, pigmentation develops, together with an anesthesia of these areas. Small and large nodules subsequently form on the areas affected. A thickening, induration and scaliness develop, together with a tenderness of the nodes. Extension of the pathologic process takes place and cicatrization and ulceration occur. *Bacilli lepræ* are found in the nodules. Lesions on the extremities are fairly frequently found.

Syphilis of the face presents as three stages—primary, secondary and tertiary. The first and second have a fairly rapid course, while the tertiary stage runs a chronic one, as is so usual with that type of case. The primary and secondary lesions are most commonly met with in the young adult, while the tertiary lesions usually occur after the age of thirty. Pain is of quite common occurrence, in the second

dary stage, while the pain accompanying the primary lesions is due usually to a concomitant inflammatory progress. The lip in all three stages is the site of selection and frequency, though the mucous patch is most commonly found within and about the angle of the mouth. The *primary lesion*, or chancre, first appears as an elevated papule which soon breaks down, forming a rounded "punched-out" ulcer with a typically sharp, sloping and indurated edge. The regional lymph glands soon become involved, forming regular, movable, painless masses. The ulceration must be differentiated from carcinoma, which can, as a rule, be easily accomplished by considering the history, the appearance of the ulcer, and the examination of the secretion; which will show the presence of the spirochete. The mucous patch of the *secondary* stage, as a rule, appears as a small, white and soft elevation with a moist secretion, which breaks down rapidly, forming an ulcer of the "flat" type, with soft, irregular and thin edges. The appearance of this type of lesion is accompanied with other secondary manifestations of the disease, such as a macular, papular or pustular rash and an enlargement of the lymph glands. The diagnosis of the ulceration of this stage of the disease is easily made, owing to its accompanying symptoms. Spirochetes may be found. *Gumma* of the lip is an infrequent disease, and appears as a hard, rounded or irregular mass which is non-sensitive to the touch. The gumma, as the process advances, may break down, discharging a sticky, almost mucilaginous, secretion.

Glanders of the face appears as (1) an acute process. (2) a chronic process. The *acute form* is marked by a very rapid onset with small nodes appearing about the chin, nose or lip, as sites of election, surrounded by very extensive zones of inflammation. Pustules, usually umbilicated, form rapidly within and about the primary involved tissue and ulcerations quickly appear. Extension of the disease is rapid, both directly and along the lymphatics, forming chains of nodes about them. Pain and constitutional symptoms of infection are usually present and the *Bacilli mallei* are found in the discharge. Cattle handlers are prone to the disease. The *chronic process* is marked by chronically discharging ulcers of the skin or mucous membrane, especially of the nasal mucosa.

Anthrax

This is an acute infection, appearing first as a small, elevated papule surrounded by numerous vesicles, with a brawny induration about the whole; the vesicles soon rupture and become covered with a dark brown or black scab; as the process advances the entire diseased area becomes discolored and a diffuse edema develops. The area involved is tender and there are constitutional disturbances which become more marked as the infection progresses. *Bacilli anthracis* may be isolated from the affected area. The disease is most common in hide handlers, woolsorters and workers in general about cattle and sheep.

Von Mikulicz's Disease

This condition is characterized by a symmetrical swelling of the parotid, lacrimal and submaxillary glands. The enlargements are entirely painless and unattended by constitutional symptoms. The disease is chronic and persistent and

shows no tendency toward malignancy. Other regional lymph glands, and the spleen, may become enlarged. Age is not an etiologic factor.

Cysts

Blood and retention cysts usually appear as small, circumscribed, painless swellings, most often found on the lips. They are, as a rule, fluctuant, but may be markedly tense. The dark red or purple color is indicative of a blood rather than a retention cyst. Injury is often a positive factor in the former.

Sebaceous and dermoid cysts of the face are essentially congenital in origin and present as small, circumscribed, semi-fluctuant, but slightly movable, masses, found most commonly in regions about the orbit, the bridge of the nose, the median line of lip and chin and about the mouth and ear. Microscopic examination differentiates them pathologically. Clinically they are identical.

Cystic hemangiomata and cystic lymphangiomata are essentially congenital in origin, are soft or semifluctuant, painless, slow-growing swellings, most often found in the cheek region. They may remain as small masses over a long period of time and then slowly progress until they have involved a goodly portion of the whole of one side of the face. The hemangioma is usually distinguished by its red or purple color.

Tumors

BENIGN

Adenoma, fibroma, myxoma and osteoma are slow-growing tumors occurring at any age, usually regular and hard, and for the most part freely movable. Of this group the osteoma is of the hardest consistency and is more likely to be adherent than are the others.

Hemangioma is not an infrequent tumor of the face, being found most commonly on the cheek and lip. It is usually congenital in origin and presents as a soft, regular or irregular, slightly elevated (as a rule) mass. At times the skin over the growth is pigmented.

Keloid is easily distinguished by the appearance of a slow-growing, hard and firm, irregular tumor along the site of scar tissue, freely movable with the skin, oftentimes painful and occurring most commonly in negroes.

Cirsoid aneurysm is a tortuous, soft and irregular mass most commonly found over the temporal region. It is a slow-growing mass. See description in chapter on "Tumors."

Lipoma, as a rule, is somewhat soft, lobulated and freely movable.

Milium and comedo should not, from the scientific standpoint, perhaps, be included in the tumor growths. They should be included in skin pathology. Their occurrence is, however, so common that it has been thought best to introduce them in the differential diagnosis. The milium is distinguished by its soft, small, pearly white or yellow, pinhead to small pea-sized conformation. The comedo is recognized by its pin point to pinhead size, slightly elevated papule containing in its center a black plug. Both, as a rule, are multiple in growth.

Papilloma of the face is essentially a growth of advanced years, but may be

Disease	Age	Progress of Affection	Location	Inflammatory Signs	Consistency	Contour	Movable or Fixed	Consistency of Skin over Region
Adenoma, fibroma, myxoma	Any.	Slow.	Any.		Hard.	Regular.	Movable.	Usually normal.
Lipoma	Any.	Slow.	Any.		Fairly soft.	Lobulated.	Movable.	Normal.
Papilloma ..	Any.	Slow.	Any.		Soft.	Irreg.	Movable.	
Osteoma	Any.	Slow.	Any.		Hard.	Regular.	Movable; fixed.	Usually normal.
Xanthoma ..	Late adult	Slow.	Inner canthus eyelid.		Soft.	Irreg.	Usually fixed.	
Keloid	Any.	Slow.	On scar tissue.		Hard; firm.	Irreg.	Movable with skin.	
Cirroid aneurysm	Any.	Slow.	Temporal region.		Soft.	Irreg.	Fixed.	Usually normal.
Milium	Youth.	Slow.	Forehead; cheeks.	±	Soft.	Regular.	Fixed.	Soft, indurated slightly.
Comedo	Youth.	Slow.	Chin; forehead; cheeks.	±	Soft.	Slightly elevated papule.	Fixed.	Soft, indurated slightly.
Hemangioma.	Congenital.	Slow.	Cheeks; lip.		Soft.	Regular. Irreg.	Movable or fixed.	Usually normal.
Epithelioma .	40 —	Slow; ulcerates.	Usually lower ear; lip, canthus.	±	Hard.	Irreg.	Fixed.	Hard or soft.
Basal-cell carcinoma	30 —	Slow.	Cheeks: skin about orbit.		Hard.	Irreg.	Fixed.	Hard.
Rodent ulcer.	40 —	Slow.	Frontal cheek.	Late stages.		Irreg.	Fixed.	Induration; ulceration.
Sarcoma	Infancy; youth.	Fairly rapid.	Orbit; eyeball.		Hard.	Irreg.	Fixed.	At first normal.
Endothelioma	Any.	Slow or rapid.	Parotid submaxillary.		Hard.	Irreg.	Fixed; movable.	Normal.
Cysts (blood retention)	Any.	Slow or rapid	Lip.		Fluctuant; hard.	Round-ed.	Fixed.	Tense.

OF DISEASES OF THE FACE

Invasion of Surrounding Tissue	Color	Regional Lymph Gland Involvement	Pain	Laboratory Data	Occurrence	Remarks
—		—	—		Common.	
—		—	—		Common.	Occasionally pedunculated.
—		—	—		Common.	Often pedunculated. (Warty.)
—		—	—		Common.	When unattached to bone is movable.
+	Yellow	—	—		Fairly rare.	
—	Pink	—	+		Common.	Most commonly found in negroes.
—		—	—		Rare.	Palpable, visible tortuosity. Pulsation. Compression of temporal artery stops pulsation.
—	Pearly white; yellow.	—	—		Common.	
—	Black plug in center.	—	—		Common.	Usually multiple.
—	Brown; purple.	—	—		Fairly common.	Slightly elevated. Skin may have normal appearance.
+		±	±		Common.	See page 108.
±		±	±		Common.	Little tendency toward ulceration or metastasis.
±		Late	±		Fairly rare.	See description of "Rodent Ulcer," page 90.
±		+	±		Fairly common.	
±		±	±		Rare.	See "Mixed Tumors," page 90.
—	Dark red; purple.	—	±		Common.	

Disease	Age	Progress of Affection	Location	Inflammatory Signs	Consistency	Contour	Movable or Fixed	Consistency of Skin over Region
Cysts (sebaceous dermoid)	O f t e n congenital.	Slow.	Orbital; median line of lip, chin, mouth, ear, bridge of nose.	±	Fairly soft.	Regular.	Fixed.	U s u a l l y normal.
Cystic hemangioma	Congenital.	Slow.	Cheeks.		Soft ; semi-fluctuant.	Regular.	Fixed.	Normal.
Cystic lymphangioma	Congenital.	Slow.	Cheeks.		Soft ; semi-fluctuant.	Regular.	Fixed.	Normal.
Actinomycosis	40 —	Slow tendency ulceration.	Cheeks; jaw.	±	Hard.	Nodular. Irreg.	Fixed.	I n d u r a t e d ; brawny.
Blastomycosis	40 —	Slow ulceration.		±	Fairly soft.	Irreg.	±	Pustule.
Tuberculosis.	Any.	SEE DESCRIPTION IN TEXT, P. 83.						
Lupus	E a r l y adult ; middle age.		Nose, lip, forehead.	SEE DESCRIPTION IN TEXT, P. 83.				
Leprosy	Any.	Slow.	SEE DESCRIPTION IN TEXT, P. 83.					
Syphilis (1st stage)	Y o u n g adult.	F a i r l y rapid.	Lip.		Hard.	Regular.	Fixed.	Ulcer, induration.
Syphilis (2nd stage)	Y o u n g adult.	F a i r l y rapid.	Lip.	±	Soft.	Irreg.	Fixed.	Papule or ulceration.
Syphilis (3rd stage)	30 —	Slow.	Lip.	±	H a r d then soft.	Regular or Irreg.	Fixed.	Hard then soft.
Glanders ...	Any.	Slow or rapid.	Chin; nose; lip.	±	H a r d then soft.	Irreg.	Fixed.	Brawny.
Anthrax	Any.	Rapid.	SEE DESCRIPTION IN TEXT, P. 84.					
von Mikulicz's disease	Any.	SEE DESCRIPTION IN TEXT, P. 84.						
Noma	Usually under 7.	Rapid.	Mucous membrane of cheek.	+	Brawny	Irreg.	Fixed.	Brawny.

OF DISEASES OF THE FACE (*Continued*)

Invasion of Surrounding Tissue	Color	Regional Lymph Gland Involvement	Pain	Laboratory Data	Occurrence	Remarks
— Unless infected.		—	—		Common.	
—	Red or purple.	—	—		Fairly common.	May involve whole of one side of face.
—		—	—		Fairly rare.	
+	Yellowish sinus.	+	±	Yellow granules; ray - fungus.	Fairly common.	
+	Blue red areola.	±	±	Blastomycotic fungus.	Rare.	Usually starts as pustule and definite ulceration forms. Surface is warty.
		+			Common.	
		±	±		Rare.	Begins as soft brown yellow nodule of skin, ulcerates or atrophies. Serpiginous.
					Rare.	
		±	+	Wassermann. Spirochete.	Fairly common.	
		±	+	Wassermann. Spirochete.	Common.	Secondary lesions.
		±	+	Wassermann. Spirochete.	Rare.	
+		+	±	B. mallei.	Rare.	Umbilicated pustules. Rapid ulceration.
+	Brown, black scab.	+		B. anthracis.	Fairly common.	Small elevated papule surrounded by numerous vesicles with induration.
		+	—		Rare.	
+	Purple mucous membrane.	+	+		Fairly common.	In institutions (especially).

found at any age. A slow-growing, warty, tumor mass, usually soft, irregular and often pedunculated, is quite characteristic of the above tumor.

Xanthoma is quite typical and presents as a small slightly elevated, slow-growing, irregular, yellow, tumor mass, situated most commonly on the eyelid and inner canthus and occurring especially in people of advanced years.

MALIGNANT

Carcinomata are usually of the slow-growing type, but under certain stimuli, known and unknown, may progress rapidly, ulcerating early and involving the surrounding parts and neighboring lymph-nodes within a few weeks. This applies most especially to the *epitheliomata*, which may lie dormant as apparently innocent tumors for a considerable length of time, assuming their malignant qualities in a most astonishingly acute course and spreading rapidly thereafter; on the whole, however, the epitheliomata are slow-growing tumors appearing usually after the fortieth year and most especially found on the lower lip, the ear and the canthus, though any part of the face may be the site of tumor growth. They may appear as hard or soft, irregular masses, usually non-mobile and showing a tendency to regional lymph-gland involvement and ulceration. Epithelioma of the face, especially of the lower lip, is more commonly found in the male, and an important causative factor undoubtedly is a chronic irritation, such as constant smoking, and especially that of a clay pipe and cigars. See "Ulceration of Lip."

The basal cell carcinoma presents many of the features of an epithelioma but the former shows little tendency toward ulceration, extension and lymph-gland involvement and is more especially found on the skin of the cheeks and skin areas about the orbit. A basal cell carcinoma is, as a rule, found in earlier years than is the epithelioma, but may appear at any time after the thirtieth year.

Rodent ulcer should not be considered as a true malignant tumor, in as much as pathologically it rarely shows as such. As the process advances, however, after a long period of development, there may be a definite malignant change in the skin and regional lymph glands. The ulceration of the skin in the late course of the disease is usually accompanied by inflammatory signs. The ulceration is, for the most part, irregular with indurated edges. It is a disease of advanced life and is especially found in women.

Sarcoma of the face is essentially a disease of infancy, youth and adult life, infancy and youth predominating. A rapidly growing tumor in infancy or early adult life, situated in the eyeball or about the orbital region, accompanied by a certain amount of pain, at times most severe, hard, indurated and irregular with early extension and regional lymph-gland involvement, should at once suggest sarcoma.

Endothelioma is extremely rare in this location, but cases have been recorded. When found it is most likely to be present in the parotid and submaxillary regions, the clinical manifestations of the tumor being described in another section of this chapter.

Mixed tumors of the face are rare, although at times they are present. Clinically they present no special differential features. In markedly rare instances a hardness

of the mass may be due to a predominance of osseous or cartilaginous tissue, or both. See under "Parotid Gland."

Clinically it is often impossible to differentiate between some of the more common growths found on the face. The onset, the consistency and the contour are so similar in many instances that the microscope or cross section will be the only means of a differentiation. Other tumors, however, present such typical characteristics that a diagnosis may easily be made without cross section or microscopic examination.

AFFECTIONS OF THE PAROTID GLAND

Inflammatory conditions	{ acute { primary secondary epidemic (mumps) abscess } chronic { chronic diffuse inflammatory fibrosis }
Granulomata	{ actinomycosis syphilis { gumma diffuse syphilitic sclerosis } tuberculosis }
Tumors	{ benign { adenoma angioma chondroma fibroma myxoma endothelioma (often malignant) lipoma mixed cell (often malignant) } malignant { sarcoma (Koenig and Kaufmann) { simple fibro- myxo- chondro- } carcinoma { medullary scirrhus } endothelioma (often benign) mixed cell (often benign) } }
Cysts	{ cystic lymphangioma retention }
Calculi	
Fistulæ	
Surgical affections of Stenson's duct	{ calculus cystic dilatation foreign bodies fistula }

Inflammatory Conditions

Acute Primary and Secondary Inflammations.—These give rise to the same train of symptoms, and their classification relates entirely to their etiologic factors. The former depends upon an inflammatory condition of the gland *per se*, while the latter is dependent upon an inflammatory process elsewhere, or occurs as a post-operative complication, in which case the gland becomes involved secondarily. The

condition is of sudden onset, accompanied by pain and swelling of the gland. There is a tenseness and redness of the skin over the gland, extreme sensitiveness on pressure and, as a rule, the gland is symmetrically enlarged and fixed. As the inflammatory process advances, the tissue may break down; the inflammatory mass changes from hardness to a state of softness or of even fluctuance, which may gradually lead to sinus formation.

The opening of Stenson's duct from the parotid gland, is situated on the inner surface of the cheek just anterior to the second upper molar. The orifice may be readily seen on looking into the mouth; a probe or catheter may be introduced into it.

The opening of Wharton's duct, from the submaxillary gland, is situated at a point lateral to the frenulum linguæ, at the apex of a small papilla. The opening, the ostium umbilicale, is so minute that it is barely visible to the naked eye.

The excretory ducts of the sublingual glands are multiple. The principal one, the duct of Rivini, or of Bartholin, opens at a point a short distance lateral to the ostium umbilicale. Swallowing of acid substances causes increased pain. The regional lymph glands usually become enlarged and tender. Clinical signs of an acute infection are present. Salivary calculi may or may not be present.

Acute epidemic inflammation or "mumps" usually occurs in children and young adults, though the condition may occur at any age. The incubation period is from one to three weeks. There is an acute onset with either mild or severe constitutional symptoms of an acute infection accompanied by local pain, swelling and tenderness. The gland becomes hard and tense, rarely reddened, though it may show inflammatory signs. It is more often bilateral than is the acute or secondary parotitis. The salivary and regional glands may be acutely inflamed. There is marked tendency to orchitis and oöphoritis.

Abscess usually follows a former acute parotitis. The gland presents as an indurated swelling with scattered or circumscribed areas of softness or fluctuance. The gland is fixed and tender to the touch and there are usually constitutional symptoms of an acute infection. The regional glands are enlarged.

Chronic diffuse inflammation often follows frequent attacks of acute parotitis. It is due to the presence of a low-grade type of infection within the mouth or to the presence of a salivary fistula or calculus. It is characterized by a slow onset and a gradual swelling of the gland. To the feel it is usually a hard, fixed, irregular, somewhat tender mass. The regional lymph glands may show some increase in size, but, as a rule, there is no tenderness. There is decreased salivation.

Chronic fibrosis is a rare condition and usually of a very slow onset; it follows a chronic parotitis. The gland becomes smaller, hard, fixed and irregular, and only becomes tender when the usual intermittent, acute attacks of pain come on. The secretion is diminished.

Granulomata

Actinomycosis is practically always from an original focus in the jaw. It presents as a slow-growing, chronic and fixed enlargement of the parotid gland, which is hard and irregular. In the later stages the gland softens somewhat and breaks down, the process involving the overlying skin and subsequently leading

to sinus formation. The resulting discharge is of the typical yellowish, granular, purulent nature. Pain is a variable factor, and the regional lymph-nodes may or may not be enlarged. Occupational predisposition pertains here, as in actinomycotic processes elsewhere, and the characteristic ray-fungus may be obtained from the discharge.

Syphilis exhibits itself in two forms, gumma and sclerosis, both of which are chronic conditions. *Gumma* is characterized by a painless, slow-growing nodule or mass, which is attached to the skin or to the gland itself and which may be either firm or soft in consistency.

This enlargement is regular and does not infiltrate the surrounding tissues. In its course, sinus formation may occur, although it is not the rule. In contrast to this form, *sclerosis* is evidenced by a gradual decrease in the size of the parotid gland, which becomes very hard, nodular and irregular. It never leads to sinus formation, while neuralgic pain and a decreased amount of saliva are prominent features of the process. Regional nodes are not enlarged in the latter condition, but may be when gumma exists. In both forms the Wassermann reaction is usually positive and improvement takes place under antisyphilitic treatment.

Tuberculosis is a rare affection of the parotid gland, and may arise primarily or secondarily in that situation. Its course is either acute or chronic and it presents as an enlargement of the gland, which is firm at first, but which tends to become lobulated and irregular, later on. It is often accompanied by pain. The surrounding skin becomes involved and often shows marked signs of inflammation. Later in the disease, a discharging sinus is formed, from which material the tubercle bacillus may be found. The regional glands may be enlarged, and a constitutional reaction is sometimes present.

Tumors

BENIGN

Adenoma and angioma are occasionally observed in this location. They are usually of slow growth, hard or fairly soft, and cannot, clinically, be distinguished from mixed tumors.

Fibroma, myxoma and chondroma present as extra- or intra-glandular growths, which are slow-growing, regular, hard and movable, though mobility is more pronounced in the extra-glandular type. A chondroma may, in certain instances, be irregular. Pain, when present, is neuralgic.

Lipoma of the parotid is extremely rare and, as a rule, may be distinguished by its mobility, lobulation and its rather soft consistency.

The benign endothelioma and benign mixed tumors give rise to the same symptoms as do the above tumors, though they are more rapid in growth and may present as either hard or soft, irregular or nodular, movable or fixed masses.

MALIGNANT

Sarcoma.—The four forms of sarcoma of the parotid recognized by Koenig and Kaufmann are usually present in the same tumor and make up the so-called mixed tumors. It is impossible to determine in any case which tissue is primarily affected because of the involvement of so many diverse tissues in this region, viz., connective

DIFFERENTIAL DIAGNOSIS OF DISEASES

Disease	Onset	Pain	Inflam- matory Signs	Pres- ence of Sinus	Consistency of Skin over Region	Consistency of Mass	Contour
Inflammation (acute, primary and secondary)	A	+	+	+	Tense; later soft	Hard; soft	Regular
Inflammation (acute epidemic)	A	+	+	—	Tense; hard	Hard	Regular
Abscess	A	+	+		Hard; tense	Hard, then soft	Regular
Chronic diffuse in- flammation	C	±	—	±	—	Hard	Irreg.
Chronic fibrosis ..	C	Intermittent	—	+	—	Hard	Irreg.
Actinomycosis ...	C	+	+	+	Ulcerated	Hard, then soft	Irreg.
Tuberculosis	A or C	+	+	+	Soft, edema- tous, ulcer- ated	Firm, lobu- lated, then soft	Irreg.
Syphilis (gumma)	C	—	+	+	—	Nodular, firm or soft	Regular
Syphilis (sclerosis)	C	Neuralgic	—	—	—	Hard, nodu- lar	Irreg.
Fibroma, chondro- ma, lipoma, ade- noma	C	Neuralgic	—	—	—	Hard or soft	Regular or lob.
Angioma	A or C	Neuralgic	—	—	—	Soft	Irreg.
Endothelioma (be- nign form)	C	Neuralgic	—	—	—	Hard, soft, nodular	Irreg.
Mixed tumor (be- nign form)	C	Neuralgic	—	—	—	Hard, soft, nodular	Irreg.
Sarcoma	A+ C	+	—	—	Early in- volved	Nodular, hard, soft	Irreg.
Carcinoma	A+ C	+	+	—	Early in- volved	Nodular, hard, soft	Irreg.
Parotid fistula ...	A C	—	—	+	Sinus		—
Parotid calculus..	A C	+	+	—	—	Hard	Regular
Cysts (retention, cystic lymphan- gioma)	A C	—	—	—	—	Fluctuant	Regular
Stenson's duct (foreign body)	A	+	If in- fected	—	—	Parotid swelling; firm	Regular

A = acute. C = chronic.

OF PAROTID GLAND AND STENSON'S DUCT

Invasion of Surrounding Tissue	Movable or Fixed	Increased Salivation	Regional Lymph Gland Involvement	Presence of Salivary Calculus	Laboratory Data	Disease
±	Fixed		±	±	B+	 Inflammation (acute, primary and secondary)
±	Fixed		+	—	—	 Inflammation (acute epidemic)
±	Fixed		±	±	—	 Abscess
	Fixed	Decreased	±	±	—	Chronic diffuse inflammation
—	Fixed	Decreased	—	±	—	.. Chronic fibrosis
+	Fixed		±	—	B+	... Actinomycosis
+	Fixed		±	—	B+	 Tuberculosis
—	Fixed to gland		±	—	B+ W+	Syphilis (gumma)
—	Fixed	Decreased	—	—	W+	Syphilis (sclerosis)
—	Movable + Fixed	—	—	—	—	 Fibroma, chondroma, lipoma, adenoma
—	Fixed + Movable	—	—	—	—	 Angioma
—	Movable + Fixed	—	—	—	—	Endothelioma (benign form)
—	Movable + Fixed	—	—	—	—	 Mixed tumor (benign form)
Early +	Fixed	—	+	—	—	 Sarcoma
Early +	Fixed Movable	—	+	—	—	 Carcinoma
—	—	Decreased	—	±	—	... Parotid fistula
—	Fixed Movable	+	—	+	—	.. Parotid calculus
—	Fixed Movable	—	—	±	—	.. Cysts (retention, cystic lymphangioma)
—	Fixed	—	—	—	—	 Stenson's duct (foreign body)

B = bacteriology. W = Wassermann.

Disease	Onset	Pain	Inflam- matory Signs	Pres- ence of Sinus	Consistency of Skin over Region	Consistency of Mass	Contour
Stenson's duct (calculus)	A	Intermittent +	If in- fected	—	—	Hard	Regular or irreg.
Stenson's duct (cystic dilata- tion)	C	—	—	—	—	Fluctuant	Regular
Stenson's duct fistula)	A or C	—	—	+	Indurated	—	—
Endothelioma (ma- lignant form)	A C	+	—	—	Early in- volved	Hard; soft	Irreg.
Mixed tumor (ma- lignant form)	A C	+	—	—	Involved	Hard, soft, nodular	Irreg.

A = acute. C = chronic.

tissue, blood-vessels, nerves, lymph and secretory glands and cartilage. In a very early case there is a small, movable tumor in front of the ear which by growth extends to the cheek and mastoid region. If a myxosarcoma is present the tumor will be soft in some areas; in other cases the mass is hard and lobulated.

Carcinoma occurs as medullary and scirrhus forms, the clinical appearance being modified accordingly. In the *medullary type* the progress is rapid, the gland being large, soft and irregular. Pain is a marked symptom, and involvement of the skin with subsequent ulceration takes place within a comparatively brief period. The regional glands are enlarged earlier than in the scirrhus carcinoma. Facial paralysis occurs commonly. Carcinomata are found especially in middle age, but may arise in younger individuals.

The *scirrhus carcinoma* gives rise to an irregular enlargement of the gland, which increases in size rather slowly, and which is not very painful. This enlargement is firm or of a stony hardness, and at times nodular. The growth is usually fixed and the skin is invaded early, often causing retraction or "dimpling."

Endotheliomata of the parotid gland, when malignant in nature, are very similar to carcinomata, but usually occur in younger people. The gland is irregularly enlarged and immobile, hard or soft in consistency, and the overlying skin is rapidly invaded. Pain is usually present, and regional nodes become secondarily involved.

Mixed cell tumors of the parotid gland may be primarily malignant, or may become so, due to malignant changes in a parotid tumor of long standing. They present as irregular, rapidly growing masses which soon invade both the glandular tissue and the skin. Often they are hard and nodular in some areas, while soft in others. They are accompanied by pain. The adjacent lymph-nodes become enlarged.

Cysts

Cystic lymphangioma is a congenital affection of the parotid gland, manifested by a regular or irregular swelling, which is, as a rule, painless, and which is soft

OF PAROTID GLAND AND STENSON'S DUCT (*Continued*)

Invasion of Surrounding Tissue	Movable or Fixed	Increased Salivation	Regional Lymph Gland Involvement	Presence of Salivary Calculus	Laboratory Data	Disease
—	Fixed	—	—	—	X-ray	Stenson's duct (calculus)
—	Movable	—	—	—	—	Stenson's duct (cystic dilatation)
—	—	Decreased or absent	—	±	—	Stenson's duct (fistula)
+	Immobile	—	+	—	—	 Endothelioma (malignant form)
+	Fixed	—	+	—	—	 Mixed tumor (malignant form)

or fluctuant upon palpation. In the course of time a cystic lymphangioma may enlarge considerably.

Retention cyst may make its appearance quite suddenly, but more often it is of long duration. Such a cyst appears as a regular, rounded, fluctuant mass, which may be movable or fixed and which in itself produces no symptoms, with the exception of neuralgic pain, due to pressure. If secondarily infected the swelling is tender and painful. A salivary gland calculus is sometimes found, obstructing one of the ducts of the gland.

Parotid Calculus

This affection is found more frequently in males, occurring usually in adult life; the symptoms may come on rapidly or gradually, and are characterized by acute attacks of salivary retention accompanied by severe pain and a swelling of the gland. The mass is usually hard and regular throughout the gland. A sudden discharge of saliva with a rapid diminution in the size of the gland is quite significant. Radiographic findings are usually positive, and a probe passed within the duct often detects the presence of the calculus. It should be remembered that symptoms are often absent until a secondary infection ensues.

Parotid Fistula

This is characterized by the presence of a communicating sinus between the parotid gland and the skin. From this opening salivary secretion is discharged, constantly or intermittently, the amount being greatly increased during meals, while the amount of saliva in the mouth is decreased. A probe passed within the sinus is admitted but a short distance. This condition follows injury, surgical operation and calculi.

Affections of Stenson's Duct

Calculus.—This affection presents a train of symptoms which may come on acutely or gradually. A marked painful swelling of the parotid gland, often in-

creased after eating, is a prominent sign. The oral orifice of the duct often shows an acute inflammatory reaction, accompanied by a seropurulent discharge. The gland is usually hard and tense, regular or irregular and shows a disposition toward disappearance and recurrence. Radiographic findings are usually positive. The calculus may at times be palpated by the finger or sound.

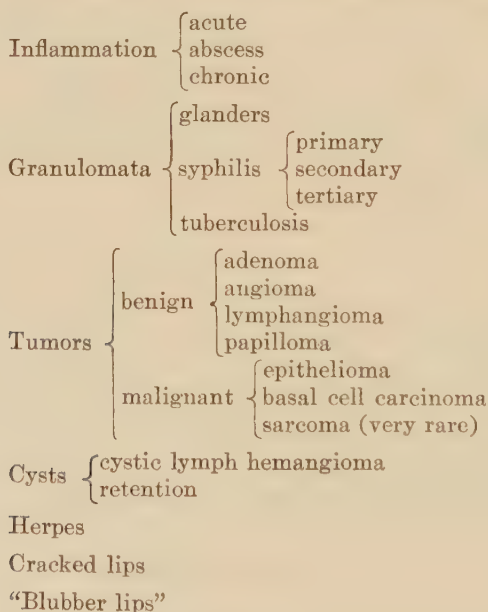
Cystic dilatation presents as an elongated, regular, painless, fluctuant, movable mass, found close to the skin of the cheek, through which saliva flows most abundantly in contrast to the flow of saliva in a parotid gland fistula. Saliva is decreased in the mouth. A probe can be passed a goodly distance into the duct.

Foreign body shows about the same train of symptoms as does the calculus, with the possible exception that a secondary infection is more apt to be present. The radiographic findings are dependent upon the type of foreign body. The condition, excluding calculus, is very rare.

Fistula.—If a fistula involves Stenson's duct there is often little tendency toward spontaneous healing. There will be a small opening on the skin of the cheek.

AFFECTIONS OF THE LIP

(For differential diagnosis see chart, "Differential Diagnosis of Affections of Lip.")



Ulcers

The conditions in which ulceration of the lip may be present are:

Anthrax
 Epithelioma
 Glanders
 Herpes
 Syphilis (primary, secondary, tertiary)
 Tuberculosis

DIFFERENTIAL DIAGNOSIS OF AFFECTIONS OF LIP

Disease	Onset	Pain	Signs of Inflammation	Ulceration	Invasion of Surrounding Tissue	Consistency and Contour	Glandular Involvement
Acute inflammation.	Sudden	+	+	±	+	Tense and regular	±
Abscess	Sudden	+	+	+	+	Soft and fluctuant	±
Syphilis, primary stage	Fairly sudden	—	—	+	—	Indurated, "punched out" ulceration	+
Syphilis, secondary stage	Fairly sudden	±	—	+	—	Soft, irregular and shallow	+
Syphilis, tertiary stage	Gradual	—	—	±	—	Elastic and regular	—
Tuberculosis	Gradual	—	±	+	+	Soft, indurated, irregular	±
Glanders	Sudden	+	+	+	+	Hard, indurated, irregular, nodular	+
Angioma Lymphangioma Adenoma	Gradual	—	—	—	—	Firm or soft, regular	—
Papilloma	Gradual	—	—	—	—	Soft, irregular, "wart-like"	—
Epithelioma	Gradual	±	—	+	+	Hard, then soft, indurated, irregular	+
Cysts	Gradual	—	—	—	—	Fairly tense and regular	—
Herpes	Sudden	±	±	+	—	Soft, "crusty," irregular	—

Anthrax of the lip is a markedly acute condition, occurring most especially in hide handlers. The lesion first appears as a papule, surrounded by a cluster of vesicles, which in turn is surrounded by an area of inflammation. The vesicles rapidly form into pustules which break down and become covered with brownish or black eschars. The ulceration is characterized by pronounced induration of its edges and surrounding tissue. Constitutional symptoms are marked. Regional glands are enlarged. *Bacilli anthracis* are found in the discharge.

Epithelioma of the lip usually occurs in male patients over forty years of age and most frequently in inveterate smokers, especially of the clay pipe and cigars. The mucocutaneous junction is the selective site for the lesion; appearing first as a fissure, papule or slight erosion. The invasion of the surrounding tissues is a prominent symptom and the amount of pain present is dependent upon the nerves affected. The regional lymph glands, theoretically, become involved early in the disease, though experience proves that they may not become invaded until the process has advanced to a marked degree of ulceration. The ulcer is irregular, fairly deep, its edges are everted and indurated and adherent to the underlying and

overlying tissues. The floor of its crater is covered with a dirty gray-red material, which has a tendency to bleed.

In rare instances, the condition assumes the aspect of a definite tumor which is hard, somewhat irregular and fixed and usually situated at the mucocutaneous junction. After variable periods of time, a breaking down of the mass occurs, and the typical ulceration appears.

Glanders of the lip is an acute process most especially seen in cattle handlers, and is characterized by the appearance of white or yellow nodules which rapidly form into pustules. Ulceration comes on quickly, and is marked by sharply defined, somewhat indurated, edges. The disease spreads rapidly, involving the deep and superficial structures, and an inflammatory reaction becomes pronounced. The regional lymph glands are enlarged, and *Bacilli mallei* may be isolated from the discharge.

Herpes of the lip consists of a crop of vesicles on a reddened, slightly elevated base, and especially are they found about the junction of the nose and lip and corners of the mouth. Within a few days the vesicles rupture and a crust forms over the site of ulceration. The edges of the ulcer are soft and friable and there is no induration of the base. The process disappears within about ten days. Itching is usually present, though a certain amount of pain or discomfort may be experienced. The etiology is varied, following as it does in the course of acute general infections, nasal infections and trigeminal nerve disease, etc.

Syphilis (*chancre of lip*) is found most commonly in young adults. The lower lip is the most frequent site. It first appears as an acute nodule or papule, which breaks down rapidly, causing a "punched-out" ulceration, with a sharply defined, straight, indurated edge, a dirty gray-red base, and a fairly deep crater. The ulceration is painless and the regional lymph glands become enlarged. Spirochetes are found and the Wassermann reaction is positive.

Syphilis of the lip in the *second stage* appears as small elevations, covered with a whitish, moist epithelial-like substance, which later may show superficial ulceration. The lesion is found most frequently about the corners of the mouth. Secondary lesions of syphilis elsewhere, history, positive Wassermann reaction and presence of spirochetes are of diagnostic value. The *tertiary stage* appears as a firm or elastic, circumscribed elevation, painless and not tender to the touch, running a chronic course, which may or may not be ulcerative. If the latter is the case, which is infrequent, the ulcer is of a sluggish type, forming in an irregular manner, with poorly defined, soft edges and with a non-inflammatory base. The regional lymph glands are enlarged. The history, positive Wassermann and reaction to treatment are confirmatory symptoms.

Tuberculosis of the lip is a rare condition and when present is generally an accompaniment of an advanced stage of pulmonary or laryngeal tuberculosis. It first appears as a slowly-growing, small, elevated, firm and painless nodule, which later breaks down, often invading the surrounding skin and producing an inflammatory reaction. The ulceration is irregular, with soft, non-indurated edges, and the floor of its crater is covered with a yellowish-gray or caseous material. The regional lymph glands may be enlarged, and the tubercle bacillus is often found in the discharge or within the tissue. Lupus of the lip has been reported.

AFFECTIONS OF THE MOUTH PROPER

Congenital deformities	{ harelip cleft-palate	
Inflammatory conditions	{ acute	{ catarrhal stomatitis ulcerative stomatitis erysipelatous stomatitis gangrenous stomatitis (noma) chronic catarrhal stomatitis
Vincent's angina		
Fetor oris		
Thrush		
Granulomata	{ tuberculosis syphilis	{ primary secondary tertiary
Tumors	{ benign	{ angioma blood-cysts fibroma mucocele
	{ malignant	{ carcinoma sarcoma
Jaw conditions (see "Jaw")		

Congenital Deformities

Harelip is a congenital malformation, characterized by a fissure or fissures in the upper lip, due to a non-union of the superior maxillary and premaxillary processes. This failure of union occurs in early embryonal life and is often accompanied by a cleft-palate. The fissure is, as a rule, lateral to the midline, although it has been noted in the latter position. Similarity to the lip of the hare has been the excuse for its accepted nomenclature. The deformity varies from only a slight notch to the most hideous of malformations, including double fissures, protruding premaxillary bones, flattening of the nose and extension of the fissures extending upward from the lip to the nasal alæ, and at times to within a short distance of the inner canthus of the eye. In very rare instances the cleft extends to, and involves, the inner canthus.

Cleft-palate is a congenital malformation, characterized by a fissure or fissures of the palate, due to embryonal failure of union of the palate. It is often accompanied by harelip. The degree of the cleft varies from that of a small area of non-union to a complete separation of the palate. Difficulty in producing the labial and guttural sounds is, as a rule, present.

Inflammatory Conditions

Acute catarrhal stomatitis occurs as a result of mechanical, thermal, chemical and microbic irritation. The characteristic signs are tenderness, redness and swelling of the mucous membrane, accompanied by a varying degree of salivation. At times ulcerative areas may be found. The condition may be mild or of a very severe type, extending perhaps to the pharynx, retropharynx, larynx, bronchi, and in-

volving the esophagus and, occasionally, the gastric mucosa. When severe, it most commonly takes the ulcerative form.

Acute ulcerative stomatitis exhibits superficial and deep mucous membrane ulcerations, extending throughout a greatly swollen and reddened membrane, involving the gums and inner surface of the cheeks, and often invading the floor of the mouth and tongue.

Acute erysipelatous stomatitis may occur as a primary infection, but most commonly it appears as an extension from an erysipelas of the face. The characteristic symptoms are an intense redness and edema of the mucous membrane of the mouth and pharynx, with often an extension to the larynx and trachea, which in turn may cause difficulty in breathing, which may, in severe cases, lead to asphyxia and death. Constitutional toxic symptoms are, as a rule, pronounced.

Acute gangrenous stomatitis or noma is essentially a condition found in poorly nourished, institutional children below the age of ten years. It occurs, at times, following the acute infections, and is most commonly seen in young girls. It should be remembered, however, that a debilitating disease without reference to social conditions may bring on the affection. Noma usually begins as a small blister, most often found on the inner side of the cheek; this affected area rapidly spreads along the mucosa, penetrating the deep tissues of the cheek and finally involving the cutaneous surface, so as to form a definite gangrenous and penetrating ulcer, which soon spreads along the external surface of the cheek. The inner and outer surfaces of the cheek are covered with a gangrenous, green-yellow exudate. The breath becomes markedly fetid and severe symptoms of sepsis appear. The disease is usually fatal.

Chronic catarrhal stomatitis is generally of a mild, though at times most annoying, nature. This condition often is present in dyspeptics and is marked by a more or less thickening of the mouth mucous membrane, accompanied by a foul and fetid breath and a certain amount of tenderness on the inside of the mouth. Often the presence of decayed teeth and the too seldom cleansing of the teeth are causative factors.

Vincent's Angina

This condition is diagnosed by the presence of the fusiform bacillus and the spirillum of Vincent, as found in smears taken from the mouth exudate. It resembles an acute stomatitis.

Fetor Oris

Fetor oris, or bad breath, although not a disease in itself, is a condition which at times demands surgery for the eradication of the cause. The etiologic factors are numerous, and it behooves us to bear them in mind when we are examining a patient with this symptom. The most important causes are:

Pyorrhea

Any pathologic condition of the mucous membrane of the mouth or pharynx

Persistent gastritis

Jaw and tooth affections

Atrophic ozena

Certain pathologic conditions of the lungs, especially gangrene, bronchiectasis, abscess and large tuberculous cavities

Thrush

This is a disease caused by the thrush fungus (*Saccharomyces albicans*) and occurs in the mouth of teething children. It is characterized by the appearance of small, gray-white plaques, covered by a thin layer of desquamated epithelium in which the fungus and other microorganisms are growing; a thin and narrow border of inflammation appears about the plaques. The finding of the fungus and the clearing up of the disease after proper treatment confirm the diagnosis.

Granulomata

Tuberculosis of the mouth as a condition, either primary or secondary, is rare. It may appear as a primary lesion in the form of an anatomic tubercle on the inner portion of the cheek or tongue, though its occurrence here is of such rarity that its appearance should be considered only as a vague possibility. As a secondary ulceration from a tuberculosis of the lung it is not of such great rarity, and usually appears as a typical tuberculous ulcer (see "Ulcers").

Syphilis may appear as a primary, secondary or tertiary lesion. In this region it is most commonly found on the tongue and buccal surfaces.

Tumors

Benign and malignant tumors are most commonly found on the inside of the cheek, soft palate, and on the floor of the mouth. Those of most frequent occurrence on the inside of the cheek are the angiomata, mucocles and carcinomata; on the soft palate, the fibromata and mucocles; and on the floor of the mouth, the dermoid and thyroglossal cysts, ranula, carcinomata and sarcomata. (See "Affections of the Tongue.")

AFFECTIONS OF THE TONGUE

Congenital	{	tongue-tie
		fissure
		macroglossia
		other conditions not considered
Injuries	{	wounds
		foreign body
Inflammatory conditions	{	acute parenchymatous glossitis and acute glossitis
		abscess
Granulomata	{	tuberculosis {ulcer
		tuberculous nodule
		lupus
		syphilis {chancre
	mucous patch	
	gumma	
	sclerosis	
	actinomycosis	
	leprosy	
	blastomycosis	
Leukoplakia		

Simple ulcerations { acute { herpetic (canker)
decubital (dental)
chronic

Cysts { ranula
dermoid

Tumors { benign { papilloma
angioma
lipoma
fibroma
adenoma
chondroma
endothelioma
osteoma
malignant { sarcoma
carcinoma

History

Age; Sex; Occupation

Family History.—Tuberculosis, cancer and other tumors, syphilis.

Personal History.—Acute infectious diseases, venereal history, ulcerated teeth. Tobacco history (including pipe and cigars). Injury. Tuberculous history; gastric disturbances.

Present Illness.—Date of onset, acute or chronic pain and radiation of same. Facts, if possible, relating to the cause of the present condition. History of hemorrhage from mouth, chills and fever, history of diet.

Physical Examination.—Site of affection. Signs of inflammation about mouth and tongue; presence of ulceration or tumor with complete description of ulceration or tumor. Tissues invaded and the consistency of same. Is tumor especially vascular; is it movable or fixed? Color and contour. Enlargement of cervical lymph glands. Examination of ulceration for *Spirochæta pallida*, actinomycotic granules and tubercle bacilli. Clinical manifestations of syphilis and tuberculosis. Wassermann.

INTERPRETATION OF HISTORY

Sex.—Carcinoma more often found in male; tongue cysts more common in the female; syphilis more common in the male, though syphilis of the tongue is quite a common disease in the female. Tuberculosis more common in the male.

Occupation.—The farmer and those employed in the growing of grain and wheat are more prone to actinomycosis.

Personal History.—*Acute Infectious Diseases.*—Acute inflammation of the tongue (acute parenchymatous glossitis and acute glossitis) often follows the acute infectious diseases.

Venereal History.—Syphilis in all its stages (namely, chancre, mucous patches, gumma and sclerosis), also leukoplakia, which so often follows a syphilitic history.

Ulcerated Teeth.—Especially the acute inflammations and the simple ulcers.

Tobacco History.—Leukoplakia, especially with inveterate smokers; carcinoma with smokers, especially of clay pipes; also the acute inflammations.

Injury.—Acute glossitis following traumatism and foreign bodies.

Tuberculous History.—Tuberculosis in all its forms is nearly always a secondary disease of the tongue.

Gastric Disturbances.—Herpetic ulcers. Ingestion of corrosive and irritating substances predisposes toward acute and chronic inflammation (glossitis); the simple and carcinomatous ulceration.

Present Illness.—*Acute Onset.*—There are but few pathologic conditions of the tongue presenting an acute onset, the principal ones being acute glossitis, the acute ulcerations and the chancre. The remaining diseases are of a chronic or subacute type.

Pain is most marked in the following: Foreign body with inflammation, acute glossitis, tuberculous ulceration, secondary syphilis, the simple acute ulcerations, and malignant tumors, especially carcinoma. Pain is, however, usually present to a greater or less degree in all ulcerative conditions.

Chills and fever are indicative of an acute inflammatory process.

Physical Examination.—*Site of affection* is suggestive of certain conditions. Thus, the decubital ulcer is usually found opposite a canine tooth, the mucous patch on the under and lateral surface, the mercurial ulcer over the entire tongue. The location is, however, of only relative importance, with the exception of the decubital ulcer.

Enlargement of cervical glands occurs in acute glossitis, tuberculosis, syphilis, sarcoma and carcinoma.

Congenital Abnormalities

Tongue-tie gives symptoms of difficulty in nursing by the infant and disturbances of articulation later on. On inspection it is seen that the tongue cannot be protruded to a normal degree, due to shortening of the frenum.

Fissure is of surgical interest in as much as it presents a cleft or fissurous malformation, perhaps partially, or almost entirely, separating the tongue into halves.

Macroglossia is an enlargement of the tongue, which causes a difficulty in articulation and swallowing. It often alters the facial expression, protruding beyond the lips.

Injuries

Wounds are of all varieties and do not require description here.

Foreign body within the tongue may cause an acute inflammatory condition with corresponding symptoms. Hemorrhage may occur.

Inflammatory Conditions

Acute inflammations may be divided into: (1) Acute parenchymatous glossitis, (2) acute glossitis, (3) abscess.

Acute parenchymatous glossitis is an acute inflammation of the tongue substance and follows injury or occurs as a complication of the acute infectious diseases. The tongue, as a whole, is swollen and thickened and its consistency is increased. This condition is quite painful and interferes with articulation and mastication, as well as deglutition. The regional nodes are usually enlarged.

Acute glossitis consists of an acute inflammation of the epithelium of the tongue, the process not involving the muscular substance. It presents as a reddening and moderate swelling of the lingual surfaces, is only slightly painful and does not interfere much with function.

Abscess of the tongue represents the most advanced stage of an acute parenchymatous glossitis. The tongue is greatly swollen and indurated and is very tender and painful. It may or may not show localized fluctuation with surrounding edema and induration, this feature depending entirely upon the location of the abscess. Abscess is usually found to one side of the median raphé, although the inflammatory process may be bilateral. Constitutional reaction is often marked, while ingestion of food and articulation may be seriously impaired, or even impossible. The regional nodes are enlarged and tender.

Granulomata

Tuberculosis.—See Differential Chart, "Ulcerative Conditions of the Tongue."

Syphilis.—See Differential Chart, "Ulcerative Conditions of the Tongue."

Actinomycosis.—See Differential Chart, "Ulcerative Conditions of the Tongue."

Leprosy appears on the tongue as tubercles, usually as a complication of the tubercles on the face. The small masses of cells contain the *Bacilli lepræ* which are easily demonstrated by scraping the lesions and staining with carbolfuchsin. The papillæ of the region involved are obliterated and the epidermis destroyed so that ulceration occurs. The condition is extremely rare.

Blastomycosis very rarely affects the tongue. It may follow a cutaneous or generalized infection. The tongue presents a small papule which becomes encrusted, warty and enlarges about the periphery. Multiple abscesses appear, surrounded by areas of bleeding granulations. The specific organism, the yeast fungus, can be demonstrated by placing the tissue or pus in a 10 per cent caustic soda solution and examining unstained through the microscope. The blastomycetes are double contoured, highly refractive bodies, 7 to 20 centimeters in length, occurring singly, in pairs or as budding forms.

Leukoplakia

Leukoplakia is a chronic inflammation of the mucous membrane of the tongue characterized by the formation of whitish patches and often terminating in epithelioma. Any part of the tongue or buccal mucosa may be affected but most commonly the condition is present on the dorsum near the tip. Tobacco seems to be an exciting cause, the lesion being also called a smoker's patch. A small red dish patch first appears which may go unnoticed; after several weeks of insidious development the patch becomes white, roundish or irregular and fairly well defined. The surface is rough and dry with a thickening of the epithelium. The lesions may be tender and painful when acids, hot or cold beverages are taken. Many of these patches grow into papilloma and become cancerous; this danger gives leukoplakia its great importance.

Simple Ulcerations

(See Differential Chart, "Ulcerative Conditions of the Tongue.")

Cysts

Cysts of the tongue are not common. Parasitic cysts have been reported.

Mucous cysts are rare but have been found on the dorsum or sides, are usually of small size, thin-walled and fluctuant.

Ranula is a cyst situated under the tongue, due to obstruction of a duct of a mucous or salivary gland. The duct may be occluded by inflammation, congenital malformation, pressure from growth or foreign bodies. The condition is most common in adults although very young children may be affected. The blocking of the duct may be temporary, permanent or intermittent. Depending on the location of the gland involved, there will be a tense or fluctuant, thin-walled, translucent bulging cyst under the floor of the mouth. The mass seldom projects below the jaw and rarely interferes with speech, swallowing or talking. In an old, chronic case the gland atrophies.

Dermoid cyst may be found in the midline of the floor of the mouth beneath the tongue. It is of a yellowish color, does not fluctuate but pits on pressure; these characteristics distinguish a dermoid cyst from a ranula which is bluish and translucent. The dermoid tends to increase slowly in size and may interfere with mastication, deglutition, speech or respiration. The cyst may become inflamed and suppurate.

Tumors

Benign tumors of the tongue are comparatively rare. The most common forms are *papilloma* and *angioma*. Papillomata usually occur in young persons and are of a warty nature, usually soft and without any induration of the base. Many of them become cancerous, later in life. Angiomata of the tongue may be in the form of a simple nevus or of a cavernous nature; they may be congenital or acquired. When superficial, the diagnosis is easily made by inspection; when deeply placed the exact diagnosis is often impossible. A *lipoma* or *fibroma* may rarely be present as a pedunculated growth; when deep-seated, the diagnosis is difficult. Other benign growths such as *adenoma*, *chondroma*, *endothelioma*, and *osteoma* have been reported but are extremely rare.

Malignant.—*Sarcoma* of the tongue is a very rare condition. The round-celled variety is more common and more malignant than the spindle-celled type. Therefore the prognosis as to duration of life depends on the type of cell involved, the rate of growth and metastasis.

Carcinomata of the tongue represent about 8 per cent of malignant growths in the male sex and are about five times as frequent in males as in females. Tobacco and alcohol are thought to be predisposing factors. The disease occurs most commonly between forty and fifty years of age; the younger the patient the more malignant is the growth. The side of the tongue, especially on the anterior two-thirds, is the region usually first involved. The condition may begin as a leukoplakia, a warty growth or as a chronic ulcer. The squamous epithelium gives rise to the carcinoma which extends directly and by metastasis to the glands under the tongue and in the neck. Ulceration usually occurs early (see "Ulcers of Tongue"). If there is no ulceration the carcinoma is present as a papillomatous growth whose surface may be fissured and whose base is characteristically indurated. Pain is an early

DIFFERENTIAL DIAGNOSIS OF ULCERATIVE CONDITIONS OF THE TONGUE

Disease	Site	Color	Contour	Base	Floor	Crater	Edges	Pain	Lymph Glands	Special Data
Herpetic ulcer (canker)	Tip, dorsum lateral	Red	Regular multiple	Soft granulations	Usually gray slough covering	Shallow punched out	Soft, straight	+	—	Usually in dyspeptics
Mercurial ulcer	Entire tongue	Whitish	Irregular multiple	Soft, no induration	White slough, red white floor	Shallow	Soft, jagged	+	—	Pyalism—history
Chronic ulceration	Dorsum, lateral	Gray white	Irregular	Indurated	Raw, gray, glazed	Shallow wrinkled	Thickened, fairly straight	—	—	History of long standing ulceration
Tuberculosis	Tip, lateral portion	Gray pink	Regular	No induration	Covered with soft caseous material	Deep	Undermined, no induration easily spread	+	+	Usually secondary
Chancre	Tip, dorsum, lateral	Red	Regular	Indurated	Usually covered by false gray red membrane	Deep, punched out	Indurated straight	—	+	History—Spirochetes—Wassermann
Mucous patch	Under surface lateral	Dirty gray red	Regular multiple	No induration	Dirty gray material	Fairly deep or shallow	Straight, well marked	+	+	Syphilitic manifestations
Gumma with ulceration	Especially dorsum	Gray white opaque	Regular	Firm, somewhat elastic	Dirty gray material	Deep	Straight	—	±	Wassermann
Actinomycosis	Tip, lateral portions	Gray yellow	Irregular multiple	Slight induration	Dirty yellow film	Fairly deep	Ragged, somewhat indurated	+	—	Granules in discharge
Carcinoma	Any portion	Dirty green gray	Irregular papillary	Indurated, fissured, no boundaries	Dirty gray green	First shallow then deep	Ragged, elevated, undermined	±	+	Histology. Age 45-60?
Dental or decubital ulcer	Usually opposite canine tooth, edge	Dark red	Irregular	No induration	Raw surface without granulations	Shallow	Soft, red, thick	+	—	Usually heals promptly on removal of irritant

symptom in most cases and increased by taking food or irritating drinks. The tongue seems stiff, and speech and mastication are interfered with. An excess of secretion of mucus and saliva may dribble from the mouth and when having a foul odor gives rise to a most distressing symptom.

AFFECTIONS OF THE JAW

Infection	{	acute
		chronic
		acute pyogenic osteomyelitis
Phosphorus		necrosis
Granulomata	{	tuberculosis
		syphilis
		actinomycosis
Tumors	{	benign {
		chondroma
		fibroma
		lipoma
		myxoma
		osteoma
		intermediate {
		fibrous
		giant-cell (sarcomatous epulis)
		malignant {
		carcinoma
		sarcoma
Odontomata	{	dental root cyst
		follicular or dentigerous cyst
		compound or composite follicular cyst
		adamantine epithelioma
		hard odontoma
Leontiasis		
Hyperplasia of superior maxilla		

History

Age; Sex; Occupation

Family History.—Tuberculosis, cancer and other tumors, including “bony enlargements,” syphilis and rickets.

Personal History.—Acute infectious diseases, venereal diseases, injury, eye, ear and nasal affections. Habitat. Difficulty with teeth.

Present Illness.—Date of onset, character. Has affection followed trauma, difficulty with teeth or nasal disease? Possibility of lead poisoning. History of discharge from nose, tooth socket or eye. Chills and fever. Salivation. Pain.

Physical Examination.—Description of condition as to following points: Unilateral or bilateral, site of jaw involved (including the specifying of upper or lower maxilla). Presence of inflammatory signs, contour of mass and extension of fracture or dislocation. Blue line. Condition of teeth. Transillumination of antrum. Wassermann, leukocytes. Examination of discharge with special reference to actinomycotic granules. Cervical and salivary lymph glands. Bleeding from mouth and gums. Discharge on pressure. Is mass movable or fixed, and is it attached to overlying skin? X-ray. Use of probe.

Infection

The two main causes for the above condition are: (1) Infection following compound fracture of the jaw, (2) infection from the teeth.

Jaw infections may be divided into the acute and the chronic, depending upon the severity and length of the inflammatory process.

Perhaps the most common symptom which the patient will present is swelling with pain. At other times the presence of a sinus will be the first sign of the existing condition. Under these circumstances it is essential that the examiner go thoroughly into the history of the case, and include in his examination a complete inspection of the teeth, together with a testing out of all of them by striking each one with some metallic instrument, in order that he may detect localized pain. The examiner should further palpate along the outer and inner portions of the alveoli for the observation of a swelling and localized pain, which may exist about or in the region of some special inflammatory focus. If a sinus is present, gentle probing added to the above should be done; in performing this procedure, loose or eroded jaw bone may be detected.

If the condition follows a fracture of the jaw there will usually be observed swelling and localized pain, with or without the presence of constitutional disturbances; a sinus may present within or externally to the mouth and at times crepitation may be felt. As the inflammatory process progresses, necrosis of the bone usually takes place and a spicule is often discharged through the sinus.

Infection from the teeth is usually accompanied by a more or less localized swelling and pain about the site of the tooth infection, and on palpation a boggy, and, at times, fluctuant mass may be felt, usually presenting at the junction of the gum and cheek mucosa, constituting a *subalveolar abscess*. Often there is a discharge of pus which may come from within or without the jaw. At times the pus may burrow through the floor of the mouth and into the loose tissue of the neck and mediastinum. In the upper jaw the infection may extend to the antrum, and may discharge into the antrum proper burrowing, at times, through the hard palate.

Acute pyogenic osteomyelitis is a serious condition and is usually accompanied by constitutional symptoms of a very stormy nature. This affection is usually found in young people, and especially selects the upper jaw. The disease has a fairly rapid onset, with severe pain referred over perhaps the whole face, accompanied by a gradual swelling of the face, the edema being most marked about the upper jaw bone. The swelling may be of a distinct brawniness, with scattered or single areas of fluctuation. The cardinal signs of inflammation are present to a fairly marked degree. As the result, the entire alveolus may be destroyed.

Phosphorus Necrosis

This was formerly of fairly common occurrence in workmen engaged in various chemical industries, particularly in match factories. At present, however, it is a rare occupational disease. It begins as a periostitis of a suppurative nature, accompanied by loosening of the teeth and a purulent discharge. Later there develops an extremely destructive necrosis of the jaw itself, giving rise to constitutional symptoms and an offensive discharge.

Granulomata

Tuberculosis is a rare affection of the jaw bone; when it does occur, it presents as a gradual swelling, found most especially about the lower border of the orbit, though it may occur in any part of the jaw bone, especially at the junction of the alveolar and palatal processes and in the body of the mandible. Constitutional symptoms may manifest themselves to a mild degree, the local ones overbalancing the general. Locally, besides the swelling and edema, there is present a bluish overlying skin, with the formation of an abscess, and as the process progresses a typical tuberculous sinus appears, with soft, flabby edges, often covered with dirty yellow and perhaps caseous granulations. Particles of bone may escape through the sinus. The regional lymph glands generally become involved.

Syphilis is a tertiary lesion of either the acquired or congenital type. The hard palate is the site most frequently affected. It presents a swelling or bulging of the roof of the mouth, which is painless and of long duration. In a more advanced stage ulceration of the mucosa occurs, roughened bone appears beneath it, or a perforation of the palate takes place. Other syphilitic manifestations include a localized periostitis of the lower jaw, and necrosis of the margins, or of the nasal process of the superior maxilla. The latter is more common in the congenital type and contributes to the "saddle-back" deformity, which is so characteristic.

Actinomycosis.—The jaw, especially the inferior maxilla, is the most frequent primary site of actinomycosis. It may also be involved secondarily from a similar process in the cheek. Farmers and grain handlers are principally affected. The disease is chronic in its course; most often there are external evidences in the form of small, multiple, nodular and firm swellings, or a superficial necrosis of the bone itself. Later, the nodules break down and form sinuses which penetrate the alveolus or cheek and discharge a thin pus, which contains the sulphur granules, typical of the actinomycotic process. Rarely, the infection begins within the body of the jaw, producing extensive destruction, but surrounded by a thickened, intact, bony shell. A form similar to *lumpy jaw* of cattle is very unusual in man. Actinomycosis is to be considered in all chronic swellings of the jaw, especially if the patient's occupation is suggestive; in the presence of sinuses, and in cases which give a history of recurring swellings or "abscesses," or of chronic bony necrosis.

Tumors

BENIGN

Chondroma is a cartilaginous tumor, occurring usually before the age of twenty-five, affecting both the upper and lower jaws. Its characteristics are its slow growth, little tendency to ulcerate, its hardness and irregularity on palpation, and destruction of the surrounding tissues by pressure rather than by invasion. The degree of pain accompanying this tumor is in proportion to the tissues pressed upon. Any tumor of this nature which shows a tendency toward rapid enlargement and extension should be looked upon with a suspicion of malignant change.

Fibroma is a slow-growing benign tumor, occurring in adult life and affecting either jaw. It may arise either from the periosteum or the body of the jaw, or within the antrum, so that it presents on the alveolar margin in the one case, and

as a bulging of the bone in the other. In both varieties, however, it is covered by a shell of bone and appears as a smooth, hard, insensitive and well-defined enlargement of the jaw, which may attain a large size and which is overlaid by normal mucosa. In the lower jaw it most often involves the middle of the horizontal ramus. A crackling sensation is sometimes obtained upon palpation. The only symptoms produced are swelling and pain, the latter depending upon the location of the growth. The slow rate of growth, the absence of ulceration and metastasis, and the radiographic appearance will differentiate malignant tumors.

Lipoma of the jaw is so rare as to be considered as a clinical curiosity.

Myxoma.—A true myxoma of the jaw is a very rare condition and presents more often as a myxosarcoma. The symptoms are identical with those of a chondroma, other than that the tumor is softer in consistency and of more rapid growth than a true chondroma.

Osteoma of both upper and lower jaw is of fairly common occurrence, the upper jaw being more often affected than is the lower jaw. The growth may be unilateral or bilateral, lending either a symmetrical enlargement of the face, or, at times, such asymmetry as to be of an almost hideous nature. The growths occur most often before the twentieth year, are stony hard and regular (occasionally irregular), of very slow growth, and give rise to symptoms only when the tumor exerts pressure upon nerve roots, when it interferes with mastication, or when it becomes infected. Deformity is the most pronounced symptom. There is an osteoma of the antrum, pedunculated in form, which may become infected, causing an empyema of the antrum of such an extent as to break into the orbit, mouth or cranial cavity. This is a very rare form of osteoma of the jaw.

INTERMEDIATE

Epulis.—This tumor, often classified with sarcomata of the jaw, is really a border-line tumor, between malignancy and benignancy. It should, however, always be looked upon with suspicion, and it is incumbent upon the surgeon to treat it as such. It is most commonly found in childhood and in young adults, and most especially in the female. It is found upon the gum or upper edge of the alveolus. Both jaws are affected and it occurs in order of frequency as follows: Near canine, bicusps, first molars, incisors (Seudder). It rarely gives rise to much pain other than that of, perhaps, mouth irritation. Its size may give rise to inconvenience. Two distinct varieties present, both clinically and pathologically: (1) The *fibrous epulis*, which is a hard, round or lobulated, smooth mass, varying in size, situated and projecting between two teeth, which it may loosen, and gradually spreading at its base over the alveolar border. It is painless to the touch and its overlying mucous membrane may be bright red, or covered with a dirty, gray-yellow slough, with ulceration. (2) The *giant-cell epulis*, which more closely resembles the sarcoma than does the fibrous type, appears as a fairly soft, at times almost flabby, small, irregular mass, seen at the gum border on the lingual surface. It is very vascular, bleeding easily. It spreads along its base, but rarely invades the bone; at times, however, the jaw bone does become invaded and a tumor with definite sarcomatous signs appears. In this type of tumor the teeth are generally lifted upward rather than pushed apart. The tumor is attached to the bone, usually by

a fairly narrow base, and gives rise to neuralgic pains, localized within one tooth, or more or less generally throughout the jaw.

MALIGNANT

Carcinoma.—This is a most common malignant tumor of the jaw and is seen most often in men, usually between the fiftieth and the seventieth years. It may start from the mucous membrane of the antrum, gradually involving the greater part of the jaw bone, or by extension from the salivary glands, neck, face, cheeks, lip or even tongue. The initial symptoms may amount to nothing more than an ordinary neuralgia, referred to a bicuspid or molar tooth, usually fairly severe, however, and often deep seated; or perhaps the bulging of the cheek, lending asymmetry to the face, with or without pain, may first call one's attention to the condition. The disease is a fairly rapidly progressive one and a chain of symptoms may follow in close order. The teeth may show signs of decay and upon their removal there may follow a distinct seropurulent discharge; disturbances of vision and protrusion of the eyeball and difficulty in mastication are part of the symptom-complex, which may also include a one-sided nasal obstruction with a feeling of fullness in the antrum. Obstruction of the tear duct may occur. The growth may be visible on examination of the nares or antrum.

An ulceration may be seen early in the course of the disease. Metastasis to the lymph glands occurs late in the disease.

Sarcoma.—The pathologic varieties of sarcoma must be, to a certain extent, considered, in as much as the clinical symptoms bear a direct relationship to the pathologic findings. We should consider sarcomata of the jaw as arising, first, from the medulla (*medullary sarcoma*), second, from the periosteum (*peripheral or periosteal sarcoma*), and thirdly, from the blood-vessel wall (*perithelioma*). The spindle, round-cell and giant-cell sarcomata comprise the varieties of tumors found, the predominating and pervading type of cell determining the name. Perithelial angiosarcoma and round-cell sarcoma are most malignant. Sarcomata of the jaw are most especially found in the youth and young adult. They are rare in childhood and old age. The spindle- and round-cell variety are most commonly found in adult life and old age, while the giant-cell variety is most frequently found in infants and children. A common site of frequency is the lower jaw, though the upper jaw is not exempt. The rate of growth varies with the type of sarcoma, the spindle- and giant-cell sarcomata growing less rapidly than does the round cell. Trauma seems to be, in many cases, a predisposing, and perhaps causative, factor.

The most common sites are the body and alveolar process, and in the lower jaw more commonly near the angle, later on involving the ramus. In the lower jaw the tumor appears as a smooth, rounded and hard swelling, lending an asymmetry to the face. The process may be of slow or rapid growth, and the subjective symptoms will depend upon the involvement by pressure or invasion of the surrounding parts.

The medullary sarcoma may rapidly break through the capsule and show, before the ulcerative stage, inflammatory signs, and, perhaps, eggshell crackling on palpation. The ulceration then presents as a soft, vascular, and, at times, bleeding mass. Submaxillary lymphatic involvement occurs. Foul discharge, with signs of

subsequent metastasis, is common. The signs of sarcoma of the upper jaw are variable, and Scudder emphasizes the following points: "A sore spot on the cheek, a swelling or lump with subsequent apparent necrosis of bone; a loosening of teeth; the alveolar margin of the jaw sore—this ulceration extending to the roof of the mouth—a lump in the nostril plugging it; a persistent foul discharge from nostril; intermittent bleeding from nose; a numbness of upper lip and cheek; a so-called 'necrosis' of the jaw for many months; the hard palate becomes flatter and later bulges; the orbital plate rises upward, causing a disturbing double vision; this double vision may be the only early symptom of sarcoma of the antrum; chronic edema of eyelids not rare; enlargement of superficial veins of face is sometimes seen, the naso-lachrymal duct being obstructed, tears will course over cheek. Edema may be noted in one-half of the nasal mucosa before it is apparent in the face." Empyema of the antrum often complicates malignant disease of the antrum.

Odontomata

Scudder divides the odontomata into the following groups:

- Dental root cysts
- Follicular or dentigerous cysts
- Compound or composite follicular cysts
- The adamantine epithelioma
- The hard odontoma

Dental root cysts are generally so small that it is usual not to consider them from a serious surgical point of view. Their true surgical importance, however, must be thought of when they increase to large proportions, or where there is infection, which may give rise in turn to stormy infective symptoms. The dental root cyst is the most common cyst of the jaw, and may affect either the upper or lower jaw. It occurs more frequently in the upper jaw, especially toward or near the midline of the mouth, or extending into the cavities of the face. When noted in the lower jaw it is usually situated on the outer edge beneath the mucous membrane. These cysts may be detected in the course of tooth extraction, but are most frequently found in their early stages, as coincidence in the course of a radiographic examination of the teeth, taken, perhaps, to detect some other tooth or jaw lesion. At first these cysts present no symptoms, but when their growth becomes large they may give rise to neuralgia, and to antrum, hard palate and alveolar deformities. They may, as they progress in size, be detected as hard, regular and smooth tumors, only presenting a fluctuant feel when they have assumed large proportions. Exploratory puncture may show the presence of a clear or milky-white fluid.

Follicular or dentigerous cysts arise from an overgrowth of some part of the follicle of a non-erupted tooth (Scudder). They usually occur in young adult life, and are most frequently found in the lower jaw along the outer side of the alveolus, near the angle. At first they give but little pain, and are detected by palpation as small, fairly hard, rounded and regular swellings, non-mobile, and, at times, almost crackling to the touch. They may reach an enormous size, though it is noteworthy that the mucous membrane is never ulcerated unless secondarily involved. The growth, as it progresses, may give an asymmetry to the face. Radiographic examina-

tion and puncture may show its presence. It should be borne in mind that a slowly growing tumor at the site of an absent tooth is very likely to be a dentigerous cyst.

Compound or composite follicular cysts are slow-growing, fairly hard, tumor masses, usually situated in the upper jaw in the region of the canine or incisor teeth, painless and rarely large, with little tendency toward extension. Puncture of the cyst usually yields a clear, or, occasionally, purulent, fluid. Radiographic examination reveals a cyst associated with the root of a tooth in a patient with a full set of permanent teeth (Scudder).

Adamantine epitheliomata are of the common benign jaw tumors. They occur most especially between the ages of twenty and forty, and affect females more frequently than males. The lower jaw, near the angle, is the site of preselection, and the presence of one of these tumors may be first recognized by a brownish, odorless discharge from the site of an extracted tooth. Its size varies considerably, and the symptoms that it may present depend upon the presence of infection and the extensiveness of the process. On palpation it may be felt as a hard or cystic, more or less irregular mass, which may either project as a distinct tumor or may appear as a localized tumor within the body of the jaw itself. In either case its fixity is pronounced. The teeth in its neighborhood are often loose and crooked; the mucous membrane shows no signs of ulceration or inflammation.

Hard odontomata are very hard, bony tumors of the alveolus, resembling an exostosis. As a clinical entity they are rare.

Leontiasis

Leontiasis, although involving most or all of the cranial and facial bones in its course, is often primary in the upper jaw. Starting, usually, in early life, there appears a very gradual, but progressive, hyperostosis, diffuse and symmetrical in character, or localized in the vicinity of the nasal process. In the latter situation the first sign is a flattening of the base of the nose. Occasionally the bony overgrowth produces bulging of the hard palate, and may loosen the teeth, while neuralgia is often associated. In other cases pressure is exerted upon the nasal cavity, the nasolacrimal duct or the orbit, causing symptoms such as nasal discharge, epiphora, protrusion of the eyeball and, infrequently, optic neuritis. Thereafter the other cranial and facial bones, including both upper and lower jaws, are symmetrically involved in a similar manner, producing the characteristic aspect and "lion-like" deformity; cerebral and aural symptoms are frequently observed. Enlargement of the terminal phalanges of the fingers is considered typical of this affection.

Hyperplasia of the Superior Maxilla

In this affection the upper jaw is the site of a chronic process somewhat akin to an hyperostosis. A gradual enlargement of the jaw, especially towards the outer side, develops, thus producing an asymmetry of the face. The swelling is perfectly smooth, and blends with the adjacent bony wall. No symptoms other than a visible facial deformity may be present, although neuralgic pain may occur, and caries of the teeth is often associated.

CHAPTER V

THE NECK

AFFECTIONS OF THE NECK

(Exclusive of All Thyroid Affections)

Inflammatory conditions	acute cellulitis {superficial deep} abscess {superficial deep} cervical adenitis (abscess) furuncle carbuncle salivary adenitis (abscess) pharyngitis retropharyngitis Ludwig's angina retropharyngeal abscess submental adenitis (abscess) chronic woody phlegmon cervical adenitis salivary adenitis
Cervical rib	
Congenital fistulæ	thyroglossal branchial cleft
Aneurysm	
Madelung's fat neck	
Wry-neck	
Esophageal diverticulum	
Granulomata	actinomycosis syphilis tuberculosis
Cystic tumors	thyroglossal cyst branchial cyst dermoid cyst cystic hemangioma cystic lymphangioma sebaceous thyroid bursa meningocele echinococcus
Affections of lymph glands	hyperplasia tuberculosis Hodgkin's disease lymphatic leukemia

Affections of lymph glands (*cont.*)

- { syphilis
- { blastomycosis
- { actinomycosis
- { sarcoma
- { lymphoma
- { lymphoblastoma
- { Von Mikulicz's disease
- { carcinoma

Solid tumors

- { benign
 - { angioma
 - { chondroma (often malignant)
 - { fibroma
 - { lipoma
 - { lymphoma (benign type)
 - { neuroma
 - { osteoma
- { malignant
 - { carcinoma
 - { lymphoma (malignant type)
 - { sarcoma

Tumors of the carotid body

History

Age; Sex; Nativity

Family History.—Tuberculosis, cancer and other tumors, syphilis, “enlarged glands,” goiter, nervous diseases.

Personal History and Present Illness.—Acute infectious diseases, including mumps and tonsillitis; venereal history; injury; exciting cause of inflammation, *i.e.*, boils, pimples, face infections, etc. History of affection from time of recognition to present date. Tuberculosis, “throat trouble,” exophthalmos, palpitation, nervousness, bleeding from mucous membranes, dyspnea, traumatism, difficulty in swallowing. Pain, character and radiation of same. Previous discharge from neck. Loss of weight. Night-sweats, chills and fever. Influence of menstruation.

Physical Examination.—Complete description of area involved; if tumor is present; location, size, consistency, contour, single or multiple (discrete or confluent masses). Condition of skin over diseased area and is mass adherent to overlying skin. Is growth diminished on pressure and does it move with respiration? Is it increased after eating? Pulsation, thrill, pain on pressure. Signs of surrounding inflammation. Are other glands in body palpable? Signs of existing sinus or discharge. Is secretion increased? Examination of pharynx and mouth, including tongue, teeth and jaws; liver, spleen, face and parotid region. Signs of bruit. Blood-pressure; radiographic examination with or without bismuth; tuberculin test, Wassermann test, blood examination. Examination of lungs and heart. Pulse and temperature.

INTERPRETATION OF HISTORY

Age

Infancy and Early Childhood

- { thyroglossal fistula
- { branchial cleft fistula
- { thyroglossal cyst
- { branchial cyst

Infancy and Early Childhood (cont.) { cystic hemangioma
cystic lymphangioma
dermoid
wry-neck
acute lymphadenitis

Young Adult { accessory thyroids
parathyroids
tuberculosis
actinomycosis
Hodgkin's disease
lymphatic leukemia
congenital cysts
sarcoma
benign hyperplasia of lymph-nodes
fetal adenoma of thyroid
physiologic parenchymatous goiter
dermoids of thyroid
benign tumors originating in skin, subcutaneous fat or connective tissue
inflammatory conditions

Adult and Middle Life { any of the above conditions
aneurysm
Madelung's fat neck
esophageal diverticulum
echinococcus cyst
thyroid bursa
cervical rib
diffuse lipoma
fibroma
osteoma
carcinoma
lymphoblastoma
toxic and non-toxic parenchymatous goiter
malignant epithelial tumors of thyroid gland and neck tissues

Old Age.—Carcinoma and aneurysm common.

Sex is of no particular value, from a diagnostic standpoint.

Personal History and Present Illness.—*Acute infectious diseases* or *tonsillitis* are often predisposing causes for acute cellulitis; acute and chronic adenitis (often follow necrosis of jaw or decayed teeth); acute retropharyngeal abscess, Ludwig's angina, cervical, submental, salivary and thyroid abscess.

Tuberculosis and *actinomycosis* often follow the acute pyogenic infections. Hodgkin's disease and acute lymphatic leukemia are often retarded temporarily in their course by pyogenic infections.

A *positive venereal history* may suggest syphilis of the cervical lymph glands, or perhaps an aneurysm.

Exophthalmos is suggestive of toxic parenchymatous goiter, though an aneurysm may present the same symptoms.

Palpitation, though a variable factor of many neck conditions, is most especially found in aneurysm, Madelung's fat neck, toxic parenchymatous goiter and metastatic nodes (pressure on big nerve or vessel trunks).

Nervousness is a most prominent symptom of toxic parenchymatous goiter, though we can conceive of it as being pronounced in any aggravated neck condition.

Dyspnea is a symptom depending upon the part of the neck encroached upon, or upon the toxic action of poisons, be they chemical or pyogenic.

Difficulty in swallowing depends upon the part involved.

Pain is a very variable factor in neck affections, though when present it generally indicates an inflammatory process or a condition in which the lesion presses upon or invades a nerve trunk or one of its branches.

Fever is an almost constant symptom of the acute inflammatory conditions and may be present in atypical forms in chronic infections, both of pyogenic, tuberculous and actinomycotic origin. The carcinomata, sarcomata, the toxic goiters and the glandular enlargements, due to Hodgkin's disease or lymphatic leukemia, are often accompanied by fever. It should be especially noted that the intercurrent acute infections, with concomitant fever, are often present in the course of the glandular enlargements (especially Hodgkin's disease or leukemia).

Menstruation usually causes an increased enlargement of a physiologic and non-toxic parenchymatous goiter. The thyroid glands of young adult females often enlarge at this period. All thyroid enlargements may show an increase in size during this time.

Acute Inflammatory Conditions

Acute superficial cellulitis of the neck is characterized by a more or less circumscribed or diffused redness of the skin, accompanied by tenderness, pain and swelling of the region involved. A tense brawniness of the skin with a certain stiffness of the neck muscles may be present. Fever, leukocytosis and enlargement and tenderness of the regional lymph glands are often found. It may terminate in *abscess*.

Acute deep cellulitis of the neck is of a more serious nature than is the superficial affection. The cellular tissue beneath the cervical fascia becomes invaded, symptoms of infection are more pronounced, including deep-seated pain, a marked stiffening of the neck, together with the appearance of swelling and a deep-seated painful induration, and perhaps bogginess, which may become extremely extensive. Systemic symptoms are most severe, including high fever, chills, drowsiness, at times delirium and anuria. Other symptoms such as dyspnea, difficulty in swallowing, etc., depend upon the site of neck region involved. The skin, in this type, may or may not be reddened. Regional lymph glands, both deep and superficial, are enlarged and tender to the touch. This condition may terminate in *abscess*.

Acute cervical adenitis is essentially an acute inflammation of a gland or glands of the neck. The etiology may be determined by a review of the topographic anatomy on page 124. In this group, the pyogens should be considered as the causative agents, and those acute swellings of the glands of the neck, accompanied by some of the symptoms of inflammation, but due to the non-pyogens, should be relegated to the "acute diseases of the lymph glands." An acute adenitis is always accompanied by a swelling and tenderness of a gland or glands, a certain amount of stiffness and soreness of the neighboring soft tissues, and often constitutional symptoms of infection. The gland or glands may be visible as discrete or confluent

masses (the latter only after breaking down or accompanied by a severe periadenitis); signs of redness may be present; rather soft and spongy to the feel; at first freely movable, later on indurated and fixed. Pain on superficial and deep pressure is usually elicited. As the gland becomes broken down, areas of *fluctuation* (abscess) will develop. The inflammatory process may remain localized, or it may spread to the neighboring tissues and contiguous glands. Regional and constitutional symptoms depend upon the site, the extent and infiltration of the surrounding tissues.

Furuncle is frequently found in the neck region, especially in the neighborhood of the posterior hair line and nape of neck; the anterior collar line just below the thyroid cartilage; and in the vicinity of the under surface of the jaw angle. It is represented by a circumscribed area of inflammation, the center of which is a hair-follicle. It appears as a hard, round, reddish, elevated node, varying in size from that of a pea to that of an English walnut; it is tender to the touch and has a tendency toward suppuration and the accompanying fluctuant feel. As the process advances a necrosis of the contiguous parts takes place, forming an opening through which pus and necrotic material are exuded, the latter often detaching itself as the "core."

Carbuncle is really an advanced stage and a more severe type of furuncle, the main anatomic difference being that in the former we have a simultaneous infection of a number of adjoining hair-follicles, accompanied, as a rule, by severe pain, a rapid extension of the process to contiguous parts, and at times a more or less severe systemic reaction. A carbuncle primarily presents as a small pimple or pustule, seemingly entirely benign as to character. Within a short time the zone of inflammation extends about the primary focus, the inflammatory infiltration becomes deeper, causing a definite induration in and about the involved area. Multiple small areas of necrosis appear; and the inflammatory process merges into the adjacent skin. The pathology is at times self-limited. Often, however, the inflammatory infiltrate burrows down and spreads out with such rapidity that strenuous operative procedure must be resorted to. The extension of the inflammatory condition often develops new furuncles which may form into definite carbuncles. The most common site of the carbuncle is the back of the neck near the hair line. Diabetic patients seem to be the most prone to the condition, though a person in apparent perfect health may be affected with the disease.

Acute Thyroiditis.—See under "Thyroid Gland."

Abscess of the thyroid gland is a common complication of acute thyroiditis. The distinguishing features are chiefly unilateral prominence of one lobe with the definite signs of either an independent induration, or fluctuation, either superficial or deep and severe pain noted over one special area upon pressure. In this condition the temperature will range as more or less of a septic type. The inflammatory process surrounding the abscess cavity may include the neighboring tissues, causing a redness and edema of the surrounding parts. Localized redness is at times seen over the site of the abscess area, though absence of this symptom should not be considered as in any way pathognomonic of the non-existence of a deep thyroid abscess.

Acute Salivary Adenitis.—This condition is an acute inflammation of the submaxillary and sublingual salivary glands arising oftentimes as a complication of a pyorrhea or caries of the teeth, an oral infection, and occasionally as a secondary

condition to a salivary calculus. It occurs at times, as a complication of the acute infectious diseases. A rapidly developing swelling, both tender and painful to the touch, found in either the submaxillary or submental region, is a symptom-complex. If the inflammatory process be confined within the glandular substance, the symptoms are not as a rule severe, but a suppuration of the surrounding tissues of the neck, encroaching very often upon the deeper structures, may cause a very severe and serious condition.

Abscess is often found as a complication of this condition and is distinguished by the sense of deep fluctuation on palpation. The systemic symptoms may or may not be severe, depending upon the severity of the infection and the extension of the disease. Dyspnea and difficulty in swallowing are two prominent symptoms of either an abscess or of separate infection.

Acute pharyngitis is, as a rule, characterized by a slight fever, malaise, a certain irritable cough and difficulty and pain in swallowing. A tonsillar infection generally gives rise to symptoms more or less severe. The pharynx and usually the soft palate are infected, and there is an excessive amount of mucus present. A radiation of pain to the ear and deafness may ensue in the so-called "streptococcus sore-throat," which is an aggravated form of an acute pharyngitis; this often leads to ulcerations of the mucous membrane, sometimes accompanied by a false membrane production, and usually associated with more marked local and general symptoms. Vincent's angina may present a similar appearance, though bacteriologic examination will prove or disprove its presence. The pharyngitis of scarlet fever consists of an intense hyperemia, sometimes accompanied by definite exudation, while that of diphtheria is characterized by the formation of a true membrane.

Ludwig's Angina.—This condition is rare and may be described as a severe, acute infection of the submaxillary or submental regions often accompanied by a gangrenous condition of the floor of the mouth. A rapidly forming swelling, with a decidedly acute onset, with the formation of induration and marked constitutional symptoms, with an *involvement of the floor of the mouth*, is a symptom-complex of this condition. The patient may present symptoms of a very acute toxicity within a few days after the ushering in of the primary condition. Difficulty in breathing and swallowing may be so pronounced as to call for immediate emergency surgery to relieve the condition. On inspection of the mouth, the tongue will be seen to be elevated to a marked degree, due to the inflammatory condition beneath it. A gangrenous stomatitis may be apparent in this region. The progress is, as a rule, toward the middle of the neck and often into the mediastinum. Locally the symptoms are those of a phlegmonous process or of an acute abscess formation. The infection is generally accompanied by great pain. In this condition it is rare to elicit fluctuation on palpation. The inflammatory process is so diffuse throughout the tight tissues of the neck that an abscess rarely occurs.

Retropharyngeal abscess occurs as a sequel of rhinopharyngitis, or of diseases such as diphtheria, scarlet fever, tonsillitis and otitis. In many cases the etiology is obscure. The majority of cases arise during the first year of life, and it is rare after the age of two years. It consists of a primary inflammation of the retropharyngeal tissues, with the secondary formation of an abscess. The latter may present as a fluctuant swelling, tender and painful, near the angle of the jaw, or may only be apparent upon pharyngeal examination where it is characterized by a

visible or palpable bulging of the posterior pharyngeal wall. The disease is accompanied by fever, malaise, prostration, dysphagia, and often refusal to nurse. Dyspnea is marked, and a nasal twang to the voice is common. Stiffness of the neck muscles, with hyperextension of the head, is quite characteristic. A retropharyngeal abscess is to be suspected in an infant who exhibits dysphagia, noisy dyspnea, mouth-breathing and a backward drawing of the head. Digital palpation of the pharynx is the most valuable diagnostic measure.

Acute Submental Adenitis.—This condition is an acute inflammation of the submental glands, and is often due to an infection of the chin skin, an infection in front of the tongue, an infection of the lip, a pyogenic infection of tuberculous glands, and as a part of a Ludwig's angina. It occurs, at times, as a complication of the acute infectious diseases and as a complication of a salivary calculus. It presents as a rapidly developing swelling, both tender and painful to the touch. If the inflammatory process be confined within the glandular substance, the symptoms are not as a rule severe, but a suppuration extending into the surrounding tissues may cause symptoms of dyspnea and difficulty in swallowing.

Abscess is often found as a complication of this condition, and is distinguished by the sense of deep fluctuation, on palpation. Unless the infection takes the type of Ludwig's angina with the extension into the submaxillary and sublingual regions, severe symptoms of infection are as a rule lacking. At times an abscess formation can be readily detected by the redness and edema over one special area of the part involved.

DIFFERENTIAL DIAGNOSIS

Acute cellulitis is an acute infection of the neck with a tender, reddened swelling, which may affect any of the connective tissue planes. If superficial, it tends to localize; if deep, to spread along fascial planes.

Acute cervical adenitis is most common in children and young adults. It follows acute infectious diseases, the exanthemata and tonsillar, mouth and nasal infections. There is an acute, painful swelling of one or more of the cervical glands, usually anterior cervical (unilateral or bilateral). Tender, regular, firm at first, later overlying inflammation and soft, fluctuant swelling surrounded by brawny induration and producing abscess, if unchecked.

Furuncle.—This condition is especially found in the back of the neck and shows a circumscribed area of inflammation—tender, red and painful, with central necrosis and but one point of communication with the skin. The regional glands may be enlarged.

Carbuncle.—Back of neck. Wide area of reddened, brawny induration with central areas of necrosis and multiple openings. Widespread blush beyond palpable margins of carbuncle. Very painful and tender, often with marked constitutional reaction and toxicity. Is often fatal. The regional glands are enlarged. Diabetics are especially prone to this affection.

Acute submental adenitis follows affections of tongue and teeth, particularly. There are acute, rounded, tender swellings below symphysis menti, which gradually subside or produce signs of an abscess, which usually remains localized.

Acute Thyroiditis.—This is rarely primary, and may be caused by any of the acute infectious diseases or local wounds, or poor teeth. Is firm, with brawny

Sites

Submaxillary triangle
Superior carotid triangle
Inferior carotid triangle
Subclavian triangle
Occipital triangle
Submental triangle
Thyrohyoid space
Submentohyoid space.
Suprasternal space
Suboccipital space

Etiology

A. Submaxillary triangle
Infectious processes in mouth
Tooth infection
Acute and chronic osteomyelitis of jaw
Inflammatory condition of salivary glands
Salivary calculus
Pyogenic infection of a tuberculous gland
Pyogenic infection of an actinomycotic gland
Secondary to acute infectious diseases
Secondary to skin infections
Secondary to an infection of Stenson's duct

B. Superior carotid triangle
Tooth infection
Infection of pharynx
Tonsillitis
Thyroid infections
Direct extension from salivary glands
Esophageal infections
Pyogenic infection of a tuberculous gland
Pyogenic infection of an actinomycotic gland
Secondary to skin infections
Secondary to acute infectious diseases
Eczema of head
Infection of nose
Direct extension from subclavian triangle infection

C. Inferior carotid triangle
Extension from an infection of thyroid gland
Osteomyelitis of manubrium
Mediastinal abscess
Pyogenic infection of a tuberculous gland
Pyogenic infection of an actinomycotic gland
Jaw bone infection
Infection of esophagus
Infection of trachea
Infection of larynx

D. Subclavian triangle
Osteomyelitis of clavicle
Pyogenic infection of a tuberculous gland
Tuberculosis of lung
Extension from an infection above
Primary infection of nodes of that region

E. Occipital triangle
Pyogenic infection of tuberculosis of spine
Osteomyelitis of occipital bone
Mastoiditis
Otitis media
Carbuncle
Pyogenic infection of a tuberculous gland
Secondary to skin infection

F. Submental triangle
Infection of chin skin
Infection front of tongue
Infection of lips
Infection of lower face and jaw
Pyogenic infection of a tuberculous gland
Ludwig's angina
Pyogenic infection of dermoid cyst

G. Thyrohyoid space
Acute thyroiditis
Infection of esophagus
Infection of trachea
Infection of larynx
Infection of thyroglossal cyst
Infection of branchial cyst
Infection of thyroglossal fistula
Infection of branchial fistula
Infection of skin

H. Submentohyoid space
Ludwig's angina
Infection of dermoid cyst
Infection of thyroglossal cyst
Infection from skin

I. Suprasternal space
Osteomyelitis of sternum
Abscess of mediastinum
Lung abscess
Infection from skin
Abscess of median lobe of thyroid
Tuberculosis of sternum or lung
Actinomycosis of lung or sternum

J. Suboccipital space
Tuberculosis of spine
Pyogenic osteomyelitis of spine
Osteomyelitis of occipital bone
Mastoiditis
Otitis media
Tuberculous adenitis
Carbuncle
Secondary to skin infection

and tender swelling on either side of larynx, moving on swallowing. Often produces pressure and toxic symptoms. It may proceed to redness of skin; fluctuation and abscess production, or abscess may discharge internally.

Acute salivary adenitis affects submaxillary gland; in children and young adults; teeth and tongue affections; calculus; there is an acute, tender, painful, rounded swelling, with constitutional symptoms and often interference with movements of the jaw and throat.

Acute retropharyngitis is found in infants and children. Follows exanthema,

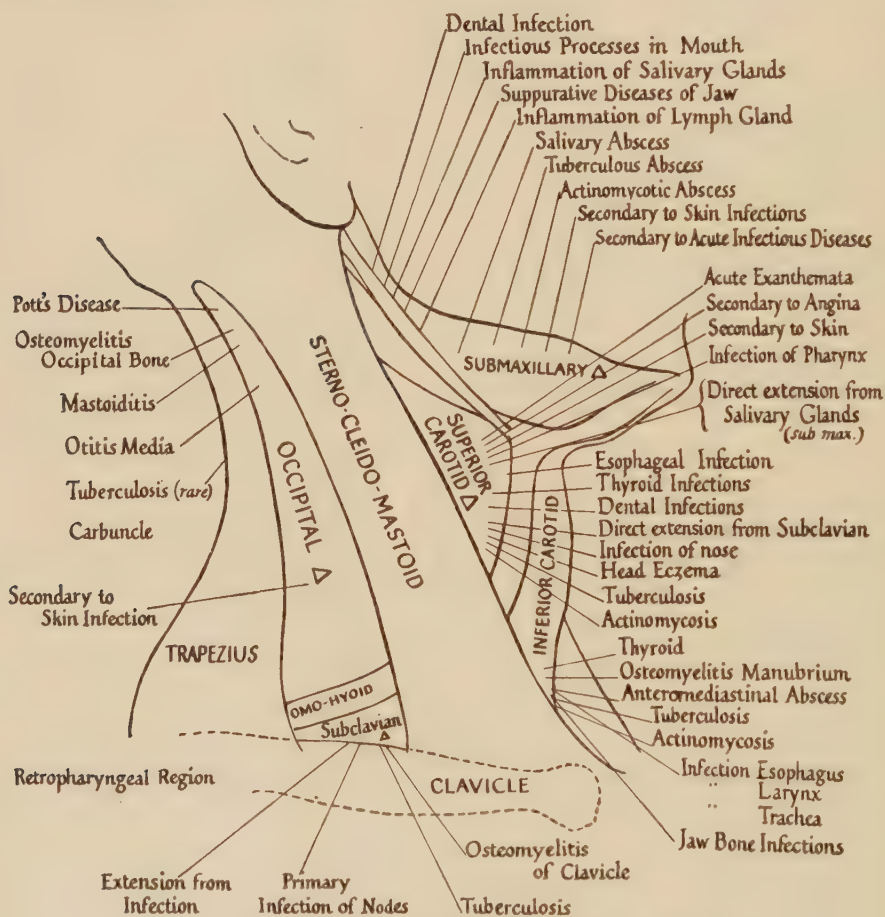


FIG. 1.—ETIOLOGIC CHART OF INFECTIONS, NECK TRIANGLES

mata, nasal and pharyngeal infections. The throat is sore, with interference with swallowing and respiration. There are constitutional symptoms; the posterior pharyngeal wall is well reddened and thickened, sometimes bulging. The signs in the neck are variable. The affection tends toward abscess.

Ludwig's angina is diffuse, with brawny infiltration of submaxillary and submental regions (later). Very acute, hard swelling with marked constitutional symptoms. There are pressure symptoms affecting voice, respiration and deglutition. It is an extremely acute phlegmonous process, sometimes leading to gangrene and always tending to spread rapidly.

Abscess.—Cervical.—Acute, tender, fluctuant or brawny, reddened swelling in any of neck triangles, most often along anterior chain of cervical lymph glands. There is temperature rise and rising pulse. Leukocytosis is present; circumscribed or diffuse. There is often a coexisting history of nasal, oral, pharyngeal or tonsillar disease; exanthemata; acute infectious diseases.

Salivary.—Acute, brawny, or fluctuant swelling in submaxillary region, with redness, tenderness and pain; it interferes with opening of jaw, which is a characteristic symptom. There are general symptoms, as well as local ones, if confined within capsule of gland. The same etiologic factors exist as in salivary adenitis.

Retropharyngeal.—There are here present exaggeration of “retropharyngitis” symptoms. The voice, respiration and deglutition are interfered with. Found especially in infants. Bulging is seen or felt in posterior pharynx. It may present as a fluctuant swelling in the side of the neck below angle of the jaw. There are severe constitutional symptoms.

Submental.—An acute swelling below the chin, rounded and tender, firm at first, later fluctuant. There are, occasionally, severe general symptoms.

Thyroid.—An acute swelling of the thyroid gland, fluctuant, tender, with signs of inflammation of overlying skin. There is a constitutional reaction, and at times there are marked pressure symptoms. (See “Acute Thyroiditis.”)

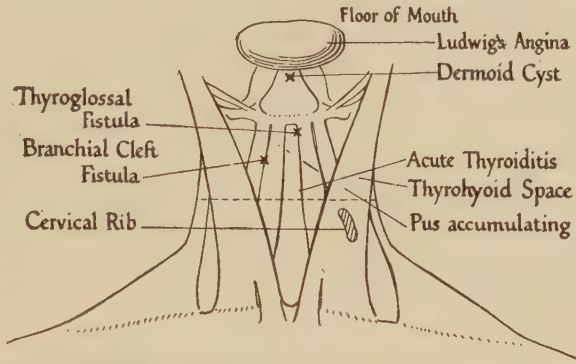


FIG. 2.—ETIOLOGIC CHART OF AFFECTIONS, FRONT OF NECK

Chronic Inflammatory Conditions

Woody Phlegmon.—This is a rare, chronic affection characterized by a hard, reddened area of the lateral or anterior region of the neck, generally wide in extent and exhibiting few inflammatory signs. The induration may break down, forming pus pockets. The affection is usually limited to the skin and subcutaneous tissues. Its etiology is, as a rule, unknown.

Chronic Cervical Adenitis.—This condition is characterized by a single or multiple enlargement of the lymph glands into which an irritative lesion of long standing has been draining. The gland or glands are freely movable, fairly hard in consistency, painless to the touch, without tendency toward degeneration and pus formation, and giving rise to no symptoms other than their presence as a mass or enlargement. If the irritative lesion is removed, there is a tendency toward retrogression in size.

Chronic salivary adenitis is characterized by the presence of a fairly hard, usually painless, somewhat adherent mass occupying the submaxillary region; frequent acute exacerbations of infection, with the accompanying symptoms of an acute salivary adenitis, form a symptom-complex of this disease. At times the condition terminates in an abscess formation.

Cervical Rib

This condition is an abnormal lengthening of the transverse process of the seventh cervical vertebra, exceptionally, of the sixth cervical. It is of congenital origin, but usually does not give rise to symptoms until adult life.

It presents as a uni- or bi-lateral, hard, bony, usually pulsating tumor mass of the non-expansile pulsating type, situated just above the inner side of the clavicles, occupying the supraclavicular region and covered by a normal skin. The train of symptoms is based upon the relation between the subclavian artery, branches of the brachial plexus and the position and extent of growth of the abnormal rib. We may, therefore, have an absence of all symptoms; only the presence of the tumor mass, or diverse symptoms, or both. Nerve pressure symptoms vary from neuralgic pains in the arm and hand and fingers to a paresis of the arm muscles. Circulatory symptoms vary from a slight weakness of the radial pulse to cyanosis, and at times, in extreme cases, to gangrene. Radiographs will confirm the diagnosis.

Congenital Fistulæ

These are of two varieties, named according to their developmental origin: Thyroglossal duct fistula; branchial cleft fistula.

Thyroglossal duct fistula is due to a failure of obliteration of the thyroglossal duct; while *branchial cleft* fistula is a similar abnormality, occurring in reference to one of the branchial clefts. A fistula of either type may form a continuous sinus from the skin of the neck to the base of the tongue or the pharynx, presenting an opening at both extremities; or, a portion of the duct or cleft may have been obliterated, leaving a sinus with but one mouth, this presenting externally upon the skin, or within the pharynx. In the former event, the fistula is complete. Also, the incomplete variety may be external or internal, according to the location of its single opening.

The essential point of differentiation between a thyroglossal duct fistula and a branchial cleft fistula is the anatomic position. The former always occurs in the midline of the neck, between the hyoid bone and the sternum. The branchial cleft fistula, in contradistinction, is found laterally between the sternomastoid muscle and the midline, and at any level between the hyoid bone and the sternoclavicular articulation. Each appears as a small rounded opening in the skin of the neck, from which a thin mucoid secretion or a thicker, whitish material discharges. In some cases food particles escape. Probing of the sinus is not usually advantageous, as the tract is commonly sinuous. Communication with the pharynx, however, may be demonstrated by injection of the sinus from the exterior, or by the oral ingestion of colored water. These fistulæ may become secondarily infected and appear as definite neck abscesses.

To summarize, the symptom-complex of a thyroglossal duct fistula consists of the presence of a sinus opening, in the midline of the neck, together with the history of its having been present at or dating from birth. A similar history, but with the sinus located laterally to the median line of the neck, constitutes the picture of a branchial cleft fistula.

Aneurysm

This condition may affect any of the larger arterial trunks of the neck, but is most commonly found in the common carotid or subclavian arteries. Less rarely the vertebral is involved, and very exceptionally the external and internal carotid arteries. Pain is very frequently associated, and, together with a pulsating sensation in the neck, is often an early manifestation. In more advanced cases there may be hoarseness, dyspnea, dysphagia, brachial and cervical neuralgias, and cerebral symptoms such as vertigo and headache. Objectively, a rounded, oval or fusiform tumor, soft or elastic in consistency, presents in the neck along the line of one of the arterial trunks. This tumor has a *pulsation* which is of the *expansile type*, and transmits a systolic thrill and bruit. Pressure over the vessel proximal to the tumor will banish the pulsation and diminish the size of the mass. In some cases, the contents being partly coagulated, the aneurysm appears like a solid mass. Pressure upon the cervical sympathetic often alters the pupil and palpebral fissure on the affected side. Pulsation distal to the aneurysm is frequently diminished as compared with that of the opposite side. In the case of subclavian aneurysm, in addition to brachial neuralgia, edema of the upper extremity often occurs, as does also the reduction of the pulse pressure. Aneurysm may result from trauma or penetrating wounds. Its occurrence is most common in middle age and in the male sex, especially those with an alcoholic, luetic or rheumatic history.

Occasionally an *arteriovenous aneurysm* is seen, as a result of a penetrating wound. In such a condition the thrill and bruit are continuous, although more pronounced during systole.

Wry-Neck or Torticollis

This is a deformity of the neck characterized by a shortening or spasm of certain muscles, especially the sternomastoid. Accordingly, the ear and occiput are approximated to the shoulder on the affected side, while the chin is elevated and rotated to the opposite side. The eyes are consequently on different planes, resulting in disturbances of vision. Upon attempts to correct the deformity, muscular resistance is encountered and pain is often pronounced. It may be either acute or chronic in its onset, and congenital or acquired. Rheumatic torticollis is acute, following exposure to cold or drafts. A spasmodic form of the disease characterized by tonic or clonic spasm is seen in nerve palsies, or arises on a functional basis.

Madelung's Disease

This disease of the neck consists of a diffuse lipomatosis. The subcutaneous tissue and fascial planes are infiltrated with fatty tissue, forming a marked double chin, and a lateral collar or roll of fat about the neck. The condition is found in men of middle age, and is often associated with multiple lipomata of other areas of the body.

Esophageal Diverticulum

This disease is most commonly found about middle age, and in the male sex. The usual site is opposite the cricoid cartilage and to the left side. Here a

mass sooner or later presents. This enlargement is usually rounded in shape, cystic in nature, appears or enlarges after the ingestion of food, and may be diminished by external pressure. The latter procedure will often produce regurgitation of food. The most constant early symptom is difficulty in swallowing. This may pertain to only a single type of food, such as hard or soft foods or liquids; and may be overcome by changing the posture of the head, or by digital pressure upon the sac in the neck. This dysphagia is progressive in severity, and regurgitation and vomiting often manifest themselves. In advanced cases there are gastrointestinal disturbances and loss of weight. Pressure symptoms, as cough and dyspnea, may arise. Material regurgitated or expressed from the sac contains no hydrochloric acid, distinguishing it from stomach contents. An esophageal bougie may enter the diverticulum and be felt in the side of the neck; or will pass smoothly into the stomach at one time, while impeded suddenly in its advancement, at another. Fluoroscopy after the ingestion of bismuth verifies the clinical diagnosis. Plummer's silk thread test will serve to differentiate stricture and diverticulum. The disease is rare before middle age.

Granulomata

(See under "Lymph Glands.")

Cystic Tumors

Thyroglossal cyst may be found at birth or in infancy, but more commonly appears at or about puberty. It is found in the midline of the neck, either above or below the hyoid bone, where *it forms a rounded or oval swelling*, fluctuant or elastic in consistency. It is adherent to the underlying tissues, but the skin is freely movable over it and there is no tenderness. The size is rarely larger than that of a pigeon's egg.

Branchial cyst arises from incomplete closure of one of the branchial clefts. Although congenital in origin, it usually appears between the ages of ten and twenty, and especially about the years of puberty. Such a cyst appears as a round swelling, elastic or fluctuant in consistency, at the side of the neck, in front of, or beneath the sternomastoid muscle. It may be located anywhere from the mastoid process to the clavicle, but the great majority are found between the greater cornu of the hyoid bone and the sternoclavicular articulation. The growth may be fairly rapid, but it rarely becomes larger than a hen's egg, and is painless in character. The more deeply situated cysts contain glairy, yellowish mucus, while those occurring superficially are largely filled with sebaceous material. There are no outstanding symptoms other than the presence of an abnormal swelling in the neck. The mass is usually movable, although not freely so, and is not tender. Deep adherence is usually to be made out, and traction on the mass at times produces a drag on the tonsil or pharyngeal wall. Fluctuation is present.

Dermoid cysts of the neck occur in the midline. The most frequent situation is just below the symphysis menti. The cyst is usually small, rounded in contour, movable and rather firm in consistency. As distinguished from a sebaceous cyst, the dermoid lies entirely beneath the skin; while its consistency is greater, as a rule, than other cysts which might be found in a similar situation.

Cystic hemangioma appears as a congenital tumor of the neck, especially along the upper portion of the sternomastoid muscle. It is deep seated, as a rule, but may appear bluish beneath the skin, when superficial. A cystic hemangioma may be as large as a cantaloupe, is smooth and regular in contour, elastic or fluctuant in consistency, attached somewhat to the deeper tissues, but movable beneath the skin. Pressure symptoms are quite frequently associated.

Cystic lymphangioma is a congenital tumor of the neck. It may occur in any situation, but is most common in the upper part of the neck, either in front of or behind the sternomastoid muscle. It forms a rounded, elastic tumor, varying in size from that of a walnut to that of a coconut. A cystic lymphangioma exhibits recurrent attacks of inflammation, during which the tumor increases in size, and there are local signs of inflammation. Although it ramifies among and adheres to the various important structures of the neck, pressure symptoms are not common.

Sebaceous cyst is most often seen in one of the anterior triangles of the neck, in the vicinity of the mandible. Its characteristics are the same as elsewhere; namely, a chronic, slowly growing, soft, rounded tumor which is adherent to the skin at a single point. It may become secondarily infected.

The thyroid bursa may become enlarged, forming a cystic swelling in the neck. Such a swelling appears in the midline of the neck, either above or below the hyoid bone, or over the thyroid cartilage. It is intimately adherent to either of these structures, although not attached to the overlying skin. In size, it is rarely larger than an olive. If infection is present the cyst is painful and tender. Upon swallowing efforts, the bursa moves upward with the larynx. It may thus be observed that, from clinical characteristics, an enlarged thyroid bursa cannot be absolutely differentiated from thyroglossal duct cysts or those of accessory thyroid glands.

Meningocele is a congenital abnormality, found on the posterior aspect of the neck in the suboccipital region. It presents as a rounded, regular mass of variable size, and is fluctuant or elastic in consistency. The overlying skin is movable over it and sometimes is altered in color and texture. Upon straining, coughing or crying the sac becomes tense. Occasionally the meningocele may be reduced and a bony defect palpated. Continued increase in size at times thins and distends the overlying skin so that the meningocele itself appears translucent. Secondary infection is common.

Echinococcus cyst is one of the rarest neck cysts. It is found especially in natives of Iceland, Australia or South America, or those who have traveled in these countries. It usually appears in the neck as a deep-seated tumor, in relation to the carotid vessels, which gradually enlarges and forces its way outward either beneath, in front of, or posterior to the sternomastoid muscle. The mass is regular or nodular, soft or elastic in consistency, adherent to deeper structures and not tender unless secondarily infected. Its growth in addition to being of a chronic nature shows intermittence as well, the mass increasing in size suddenly, accompanied by pain and tenderness. Pressure symptoms arise in advanced cases when the growth is of considerable extent. The fluid aspirated from such a mass is clear and contains the typical hooklets. A vibratory thrill upon palpation is diagnostic, but very exceptionally observed.

Disease	Age	Location	Size
Branchial cleft cyst	Puberty, occasionally present at birth	Lateral part of anterior triangle, but particularly between hyoid bone and sternoclavicular articulation	Rarely larger than a hen's egg
Thyroglossal duct cyst ..	Puberty. Infrequently present at birth	Midline of neck, above or below the hyoid bone	Small, rarely larger than a pigeon's egg
Dermoid	Especially infancy	Midline of neck, near lower jaw	Small
Sebaceous	Any	Anterior triangle	Small
Hemangioma	Congenital	In relation to sternomastoid muscle: deep or subcutaneous	Any size
Lymphangioma	Congenital	In front of, or behind sternomastoid, particularly upper portion	Any size
Cystic goiter	Mostly adults	Median line or lateral, near thyroid cartilage	Any size
Parathyroid and thyroid (accessory)	Adult	Median line or lateral, near hyoid bone	Small
Thyroid bursa	Adult	Median line, in close relation to hyoid bone or thyroid cartilage	Small
Meningocele	Congenital	Median line, posterior surface	Small or large
Echinococcus	Mostly adults	In relation to carotid vessels. Deep	Small or large

Affections of Cervical Lymph Glands

These are both varied and numerous. Certain more or less chronic enlargements of these structures are of unusual importance and form an interesting problem in surgical diagnosis.

Hyperplasia of the cervical lymph-nodes is seen especially in children. This may be part of a general condition in which the various lymph glands of the body are somewhat enlarged, retaining otherwise their normal characteristics. More often, however, the hyperplasia is confined to one or more nodes or a single group, particularly the anterior cervical chain, but it may be bilateral. The affected nodes are fairly soft, rounded, or oval, regular in contour and freely movable; they are discrete and neither tender nor painful. Some inflammatory or infective focus within the particular drainage area is often demonstrable, or there is a history of preceding acute disease. The natural course of such glands is to persist for some time, if dependent upon an unrelieved factor, such as decayed teeth or chronic tonsillitis.

Tuberculosis of the cervical lymph glands is most common between the ages of one and twenty years, but may be seen at any time of life. It is a chronic

CYSTS OF THE NECK

Consistency	Movable or Fixed	Special Data
Fluctuant or fairly firm	Adherent to deep structures. May indent pharyngeal wall on traction	Intermittent change in size in some, with discharge of material into pharynx. Infrequently secondarily infected
Fluctuant or elastic	Adherent to underlying tissues	Always moves upward when the tongue is protruded
Firm	Movable	
Soft	Adherent to skin at one point	May become secondarily infected
Fluctuant or elastic	Attached to deeper tissues	Faint bluish tinge through skin when superficial. Pressure symptoms common
Fluctuant	Adherent to deeper tissues	Subject to recurrent attacks of inflammation, with changes in size. Pressure symptoms rare
Elastic	Movable or somewhat fixed	
Firm	Fixed to deeper tissues	Rare
Elastic	Adherent to deeper structures	Moves with deglutition. Occasionally secondary infection
Elastic or fairly firm	Adherent to deep structures	Becomes tense when crying or straining. May be reduced slightly by pressure. Infrequently can palpate bony defect. X-ray
Soft or elastic	Adherent beneath skin	Natives of, or travelers in, foreign countries. Secondarily infected. "Thrill" on palpation

affection but may come on rather acutely, especially after an attack of measles, whooping-cough or other disease. The majority of cases are unilateral, although a bilateral pseudoleukemic form does occur. The favorite sites of origin are the nodes of the submaxillary region and of the upper part of the neck in front of, beneath, or posterior to the sternomastoid muscle. A painless, slowly growing swelling appears in one of these regions. In its early stages it is rounded and smooth, shows very little attachment to surrounding tissues, is not tender, and is fairly firm in consistency. Usually, several adjacent nodes can be felt enlarged; as the condition advances, the nodes become adherent to surrounding structures and to each other, fusing to form larger masses, which rapidly break down, forming a tuberculous abscess. At this stage the presenting enlargement is soft in consistency, fixed to the underlying tissues and the skin, and either regular or nodular. Definite fluctuation may be detected. The overlying skin is frequently reddened, or may appear bluish. The tendency of such a process is to form one or more sinuses, discharging caseous material or a yellowish pus. The tuberculous sinus has a characteristic purplish color and is lined by pale, edematous granulations. Pallor, loss of weight and secondary anemia accompany later stages of the disease. The tonsils or other foci in the pharynx or mouth are often the primary sites of tuberculous

infection. In children under two years of age the von Pirquet test is an aid in diagnosis; in older people, the tuberculin reaction may be of value, in doubtful cases.

Hodgkin's disease, or pseudoleukemia, is a commonly fatal affection characterized by progressive enlargement of the lymph glands. It is most common in the male sex, and occurs especially between the ages of ten and forty years; principally, however, in young adults.

Rarely, the onset is acute; usually it is insidious, the first symptom being enlargement of the lymphatic glands. This is usually primary in the cervical region, affecting the anterior cervical chain or the glands of the supraclavicular region. It may be confined to one side of the neck or be bilateral. In the first stages the glands are enlarged, firm or elastic in consistency, regular in outline, discrete and movable. As the disease progresses the glands become adherent to each other because of periadenitis, forming larger masses which are hard in consistency and which are markedly fixed. Pressure symptoms, such as dyspnea, dysphagia and severe pain, now manifest themselves. Progressive enlargement of other glands occurs after a variable interval, swelling appearing in the axillary and inguinal regions, and oftentimes affecting the mediastinal and retroperitoneal glands as well. The successive involvement of these areas is often preceded by a period of high fever. The spleen becomes enlarged, as does also the liver. At first the general health is good; later anemia develops and the patient loses weight and strength. The glands rarely, if ever, suppurate. In some cases the mediastinal or retroperitoneal group is the first to be involved, the initial symptoms being those of pressure in that particular region. The external groups later enlarge, together with the spleen, and the subsequent course is as described.

The blood-picture is in no way characteristic. The usual findings consist of secondary anemia features and a moderate lymphocytosis. Eosinophilia is fairly common.

Lymphatic Leukemia.—In lymphatic leukemia the cervical glands are commonly involved. The nodes are enlarged, smooth and regular, freely movable, and are not tender. The affection is almost always bilateral, and glandular enlargements in the groins and axillæ can usually be detected as well. In this disease the glands always remain discrete; are somewhat elastic in consistency; are painless; they do not degenerate or suppurate. Blood examination will reveal a typical picture. There is a marked leukocytosis with a preponderance of mononuclear cells; these features are diagnostic.

Syphilis affects chiefly the glands of the *posterior cervical chain*, especially in the suboccipital region. The nodes are discrete, freely movable, firm and not tender and vary in size, up to that of a bean. No symptoms are produced by their presence, although mild neuralgia may be associated. This enlargement takes place in the secondary stage and is part of the general lymph-gland hyperplasia, so that similar nodes are usually found in the groins, epitrochlear regions and axillæ. Oftentimes a specific history is obtainable, while in other cases there are other coexisting secondary manifestations, as a persistent chancre. The Wassermann reaction is usually positive during this stage. When a primary chancre occurs within their domain, one or more nodes of the submaxillary or anterior cervical regions usually becomes painlessly enlarged and hard. The diagnosis of the type

of such an enlargement depends upon the recognition of a chancre of the face, lip, tongue or tonsil. The Wassermann reaction is not apt to be positive at this time.

Blastomycosis and Actinomycosis.—See chapter on "Infections."

Sarcoma of the cervical lymph glands or *lymphosarcoma* (age: young adult) arises as a primary affection in a single node. At first the involved node is merely enlarged and hard. Soon, however, it increases rapidly in size, infiltrating the overlying tissues and becoming adherent to the skin. A large, hard, irregular mass is thus formed, and ulceration of the skin follows with subsequent areas of sloughing. Pressure symptoms such as dyspnea, pain and dysphagia are commonly present. The course is rapid and metastases are early. Adjacent glands are not involved, as a rule.

Malignant lymphoma and lymphoblastoma present the clinical picture described under Hodgkin's disease. Indeed, accurate pathologic differentiation is frequently impossible, and under the existing status we may consider the terms as interchangeable, or at least analogous.

Von Mikulicz's disease affects the lacrimal and salivary glands, producing a chronic, painless and symmetrical enlargement of those structures. Bilateral gradual swelling in the submaxillary regions should always suggest this possibility, the diagnosis being confirmed by observing a similar brawny enlargement of the lacrimal glands. The sublingual and parotid glands may also be involved, the latter very rarely.

Carcinoma.—The great majority of carcinomata of the neck are secondary to carcinoma of the tongue, lip, mouth, larynx and pharynx. Metastasis from the primary source is shown in its first stages by firm, painless, movable and moderate enlargement of the cervical lymph glands. Later in the course of the affection, the size increases, one or more glands often fuse to form larger masses and the surrounding tissues become involved, rendering the glands less movable or firmly fixed. Pain and pressure symptoms develop when vital structures are encroached upon.

Primary carcinoma of the neck is exceedingly rare, but may occur in two forms, true *epithelioma* and *branchiogenic* carcinoma. The former arises primarily in the skin, and its characteristics are those of epithelioma elsewhere. Branchiogenic carcinoma has its origin in the lining membrane of a branchial cleft, or may arise in a preëxisting branchial cyst. Because of its origin in the deep-seated tissues of the neck, a branchiogenic carcinoma does not present symptoms at once. In fact, it is usually unobserved until it has progressed toward the surface, although pain is in some cases a marked symptom and leads to the finding of a deep-seated tumor. The second branchial cleft being most often affected, a mass is found in the upper anterior angle of the neck below the mandible and anterior to the sternomastoid muscle. This is firm, regular or nodular, shows slight if any tenderness, and its adherence to underlying tissues can usually be recognized. In advanced cases there is also adherence to the overlying tissues and skin, with subsequent ulceration. The regional lymph glands may not appear to be involved until late in the disease, but they should always be regarded as potential risks.

Tumors of the Carotid Body

Tumors of the carotid body are very rare and have been diagnosed before operation in only one reported case (Keen). Most of the cases occur before forty years of age but no other etiologic factors are known. The tumor is first noticed as a small mass lying near the bifurcation of the carotid artery, between the jaw and the hyoid bone. The size is usually very small, rarely becoming as large as a hen's egg. The preoperative diagnosis is either benign enlargement of a lymph-node or lymphosarcoma. The tumor mass may seem to pulsate because of its proximity to the large vessels; there may be vasomotor disturbances such as flushing of the head, neck and face. Microscopically the tumors have been termed perithelioma or endothelioma. Recurrence follows late or incomplete removal.

AFFECTIONS OF THE THYROID

Congenital hypertrophy

Vascular changes { hyperemia and congestion
hemorrhage
vascular goiter

Inflammatory conditions { acute thyroiditis
abscess of thyroid
woody thyroiditis

Granulomata { syphilis
tuberculosis

Goiter { colloid
simple parenchymatous
adenomatous
fetal adenomatous
exophthalmic
thyrotoxic

Parathyroid tumors

Accessory thyroids and parathyroids

Accessory parathyroid cysts

Thyroid bursa

Dermoid cyst

Hydatid cyst

Teratoma and mixed tumors

Accessory thyroids

Malignant tumors { sarcoma
perithelioma
endothelioma
carcinoma

Hypothyroidism { cretinism
myxedema

Many attempts have been made to correlate the pathologic and clinical findings in diseases of the thyroid gland, and to establish a classification which will portray these two elements. Such classifications, however, are not altogether satisfactory or applicable, since the variations of abnormal thyroid histology and symptomatology are numerous, and the clinical findings are not always consistent with the microscopic data. We have, therefore, adopted a classification which includes the important affections of the thyroid gland and which at the same time lends itself most readily to the application of the principles of surgical diagnosis. Hence, the clinical aspect has been made prominent.

Congenital Hypertrophy

Congenital hypertrophy is seen at or shortly after birth. The gland is usually symmetrically swollen, but rarely attains a large size. It has the "butterfly" shape, is smooth, regular and fairly soft in consistency and moves with the larynx. Retrosternal growth is very rare. Congenital hypertrophy is commonly of the parenchymatous type but, occasionally, it is of vascular origin and then probably originates from mechanical factors attendant upon delivery. No symptoms may be produced. When the enlargement is marked there are severe dyspnea and cyanosis, noisy respirations and fretfulness. Because of the difficulty in breathing and swallowing the infant refuses to nurse. Depending upon its nature, such a goiter may recede or it may progress to such size that emergency surgery is demanded.

Vascular Changes

Hyperemia and Congestion.—These are vascular changes occurring in many women during the menstrual periods and pregnancy and also at the time of puberty. The gland is soft and symmetrically enlarged, producing a visible fullness in the neck but causing no discomfort. Boys at the adolescent stage may exhibit a hyperemia of the thyroid. It is typical of these affections, that they are only temporary.

Hemorrhage rather infrequently takes place into a preëxisting goiter. Such an occurrence is indicated by a sudden increase in size of the goiter and possibly exaggeration of the pressure symptoms. If the hemorrhage is extensive, dyspnea and cyanosis become marked. Limitation of the fluid blood will produce a cystic area within the gland, the etiology of which may be surmised from the history. The mobility of the gland is very little altered, if at all. A bruit and thrill may be heard over the site of hemorrhage. In this event the absence of toxic symptoms will rule out Basedow's disease.

Vascular goiter is often described and the term frequently applied to thyroid enlargements in which the vessels are congested or prominent. This condition is not an entity but may be seen with any variety of goiter, particularly those of large size. The goiter of Graves's disease is abnormally vascularized, explaining the visible pulsation and the typical thrill over the gland in that disease.

Inflammatory Conditions

Acute thyroiditis may occur in a normal gland or in a preëxisting goiter. In the latter it is known as a strumitis. The onset is acute with pain in the thyroid

region, fever and sometimes a rigor. A demonstrable swelling of the gland is not present at the outset but makes its appearance within twenty-four hours. One or both lobes are involved, the site of swelling being firm and extremely tender. The overlying skin is often reddened and infiltrated, and a diffuse edema may appear. Any movements, particularly those of swallowing, exaggerate the local pain. Radiation of pain to the shoulders and occiput is common. A striking feature is the acceleration of the pulse rate, which is beyond the usual pulse-temperature ratio. A history of trauma to the gland or of a recent acute fever can often be obtained or an infective focus elsewhere in the body can be detected in practically every case of acute thyroiditis. The disease reaches its height quickly in most instances. Its tendency is to recede within four or five days but it occasionally progresses to *abscess formation*. Toxemia is often marked in thyroiditis.

Abscess of the thyroid represents an advanced stage of an acute thyroiditis. Clinically, it is manifested by a septic temperature and exaggeration of the signs of thyroiditis. The local swelling and infiltration in and about the thyroid become more marked; the redness and edema of the skin increase and upon palpation there is either brawiness or definite fluctuation. Leukocytosis and the usual constitutional reaction are present. In fact, toxemia may be severe. The face is flushed, the surface temperature raised and there is general prostration. In exceptional cases, edema of the larynx necessitates emergency procedures.

“Woody” thyroiditis of Reidel is an unusual condition occurring more often in men than in women, and especially between the ages of thirty and forty—at a younger age than most carcinomata, which it sometimes absolutely simulates. Unlike carcinoma, the woody thyroiditis is more common in a normal gland, very rarely being superimposed upon a goiter. Crotti styles the condition as being due to the thyroid response to infection by hyperplasia as well as fibrosis, forming a hard, “woody” enlargement of the gland, which is fixed and immobile. He cites the following important points in diagnosis: The goiter develops very rapidly within a few weeks or months and is accompanied by intense shooting pains in the thyroid region. Dyspnea is early and very urgent. The thyroid region is hard in consistency, like iron or wood, and the cervical muscles, larynx, trachea and carotid are all involved in the infiltration. Yet, the trachea is not displaced unless goiter previously existed. The cervical lymph-nodes are seldom enlarged. To further quote: “The extreme hardness, its regularity of surface, its marked diffuseness of limits, the involvement of the gland *in toto* will remind one more of woody phlegmon than of a cancer of the thyroid, especially if the disease is found in a young individual, and if it has evolved rapidly and caused early dyspneic symptoms entirely out of proportion to the size of the tumor.”

Granulomata

Syphilis of the thyroid gland is not frequent. It may manifest itself in two forms. In the *secondary* stage of the disease, the thyroid may present a diffuse, symmetrical and regular enlargement which produces no subjective symptoms and which does not persist. *Gumma* may occur in the tertiary stage. A hard, nodular tumor is found in the gland, which is fairly rapid in growth and which is attended by pressure symptoms. Other signs of syphilis, the Wassermann reaction,

and the effect of iodids will differentiate the condition. Gumma usually occurs earlier in life than carcinoma. Instead of gummatous formation, a diffuse sclerosis of the thyroid may occur during the tertiary period.

Tuberculosis is almost invariably secondary in the thyroid, and is seen especially in young women. *One form*, the most common, gives rise to a nodular, hard tumor of one lobe, the limits of which are not well defined. The growth is painful upon pressure, and increases in size rather rapidly. In the *second form*, there is a diffuse fibrosis of the entire gland, producing a firm, immobile swelling. The infiltration may extend to surrounding structures, the clinical picture then being that of woody thyroiditis.

Goiter

While any enlargement of the thyroid gland constitutes a goiter, or swelling, we have chosen to limit its application to certain pathologic conditions. Accordingly, we may consider a goiter as being a thyroid gland enlargement dependent upon a new growth of tissue or perversions of secretion and not of an inflammatory nature or of proved bacterial origin.

Thyroid gland enlargements have certain characteristic features which make their identification as such possible. Preliminary knowledge of the anatomic relations and shape of the thyroid gland is essential to accurate diagnosis. It will be recalled that the thyroid gland consists of an isthmus or central transverse portion which lies over the second and third rings of the trachea, and two lobes or lateral portions which are disposed over the thyroid and cricoid cartilages and the sides of the trachea. A fourth lobe or pyramidal process sometimes extends upward in the median line; less frequently it passes upward from one of the lobes, and is lateral. *The lobes are intimately adherent to the cricoid cartilage and therefore move up and down with the larynx, upon deglutition.* This fact is a cardinal diagnostic sign. The sign is in relation with the trachea, larynx, esophagus, recurrent laryngeal and vagus nerves, the common carotid arteries and jugular veins, the parathyroid glands, the sternomastoids and infrahyoid muscle group and the deep cervical fascia. Disturbance of function of any of these structures may easily result from pressure upon them or distortion of a goiter, or by implication within its limits. Thus, dyspnea often occurs from pressure upon the trachea; dysphagia from pressure upon the esophagus; and hoarseness from involvement of the recurrent laryngeal nerve. Also, the trachea, esophagus and carotid vessels are frequently distorted and displaced by goiters, being then found in abnormal anatomic situations.

Any type of goiter may be present at any age. A goiter may be of any size or shape. The normal thyroid gland is not palpable. If the gland as a whole is involved, the goiter assumes a typical "butterfly" appearance; if the isthmus alone is affected, there is a median line tumor; while a lobular involvement presents a more laterally situated mass. One lobe may be larger than the other or of different contour or consistency. Occasionally a goiter grows downward, becoming *retrosternal* in location, producing dyspnea and often cyanosis, as well as enlargement of the superficial veins of the thoracic wall and neck. A mass may be felt just above the episternal notch or the area of retrosternal dulness may be enlarged

upon percussion. Pyramidal lobe enlargement is rarely seen alone. A goiter is usually more mobile transversely than it is vertically.

It is obvious that the objective findings vary considerably in different cases. In addition, the clinical picture is often complicated or even dominated by disturbances of function of the gland itself. The thyroid gland has an internal secretion which plays an important part in physical and mental development and in maintaining equilibrium of the body, acting either antagonistically toward, or in conjunction with the products of the other glands of internal secretion. Alterations in the amount secreted or perversions of the substance itself will give rise to certain symptom-complexes. In the case of *hypothyroidism* or deficient thyroid function, myxedema or cretinism results. The gland is rarely palpable; yet these conditions may occur in the presence of a goiter. In the case of *hyperthyroidism*, or excessive thyroid function, Graves's disease or a modified form of thyrotoxicosis results. Here the gland is usually enlarged. However, an overwhelming toxemia may be present without objective clinical enlargement. Also, thyrotoxic symptoms may be superimposed upon any type of goiter, such as a colloid or parenchymatous enlargement.

Moreover, no pathologic process in the thyroid runs true to type, necessarily; and the symptoms produced are not always referable to a definite pathology or pathologic physiology. In view of these anatomic, physiologic and pathologic diversities the following generalizations may be advisable and beneficial:

The parenchymatous goiter is usually symmetrically enlarged, smooth and fairly soft; soft nodules may be scattered throughout its substance.

The colloid goiter is usually more evident in one lobe than the other; and is characterized by its irregular and nodular surface. Its consistency often varies, but it is usually firm.

A cystic goiter is indicated by the presence of a smooth, elastic or fluctuant tumor which is movable.

An adenomatous goiter presents single or multiple, soft, freely movable nodules.

The exophthalmic goiter is firmer in consistency than is the parenchymatous swelling, and is of comparatively small size.

Sudden increase in size of a goiter suggests hemorrhage, infection, malignancy and hyperthyroidism.

A nodular goiter may be colloid, adenomatous, malignant or teratomatous. If freely movable and either single or multiple, it is probably adenomatous. Fixed nodules are usually carcinomatous, and they are firm in consistency.

Relatively early development of hoarseness suggests very strongly the presence of malignancy.

Incorporation of the carotid within the goiter is presumptive evidence of malignancy, while displacement of that structure is usually due to enlargements of a benign nature. Woody thyroiditis may exactly simulate malignancy in this respect.

A bruit may be heard over the gland in exophthalmic goiter, and in some colloid goiters. Pulsation and thrill often accompany the murmur.

Thyroid affections in general are more common in women than in men.

The symptoms produced are not necessarily in proportion to the size of the goiter.

Colloid goiter gives rise to a typical thyroid enlargement or affects one lobe or isthmus. Usually the goiter is symmetrical, the lobes being unequally involved. The rate of growth is very slow, but the goiter may become as large as a fetal head, causing pressure symptoms such as dyspnea, cyanosis and dysphagia. The swelling as a whole is irregular and nodular, the irregularity being of a massive or lobular character. The consistency is apt to vary in different areas, but is usually firm. Vascular phenomena frequently supervene, increasing the size of the goiter and being evidenced by pulsation, thrill and systolic murmur. If hemorrhage takes place within a colloid goiter, a definite cystic area may be observed upon palpation. While a colloid goiter is benign in the ordinary sense of that term, it may threaten life by its size and position, particularly if a portion of it is retrosternal. There is also a variety of goiter, known as *metastatic colloid goiter* which metastasizes to the lymph-nodes and bones; yet both the metastatic areas and the original goiter are essentially colloid in nature, and do not exhibit histologic features of malignancy. Symptoms of thyroid intoxication may be added to those of a colloid goiter. Fibrous and calcareous changes modify the consistency of a colloid goiter.

Simple parenchymatous goiter is observed especially in young women at the time of puberty and during menstruation, pregnancy and about the menopause. Subjective symptoms are not prominent, as a rule, but dyspnea and difficulty in swallowing may occur. It is not unusual to observe also a certain amount of nervousness and tremor.

Adenomatous Goiter.—An adenoma of the thyroid gland may be large or small, appearing as a movable, rounded, firm enlargement of a portion of the gland. Its limits can be easily defined by the palpating hand. If of sufficient size, dyspnea is produced. An adenoma may increase rapidly in size and produce recurrent laryngeal paralysis. Multiple adenomata, each of which bears the characteristics of a solitary adenoma, may be observed, scattered throughout the thyroid, which may be the seat of a single parenchymatous swelling. The thyrotoxic goiter in many instances is an adenomatous one. Cystic degeneration produces a small or large, circumscribed, fluctuant tumor, a condition which is often classified as *cyst adenomatous goiter*.

Fetal adenoma of the thyroid is of embryologic origin, as its name implies, but makes its appearance most frequently in young girls between the ages of ten and twenty years, and especially about the time of puberty. There are usually several adenomata within the gland substance, although some of these may not approach the surface. Yet, multiple nodules can be palpated. Such nodules are movable, non-tender, firm in consistency and are easily delineated from the glandular structure, their limits being sharply defined. An individual adenoma grows slowly and seldom becomes larger than a hen's egg. Accordingly, pressure symptoms are exceptional.

Exophthalmic goiter, also known as Graves's disease, Basedow's disease and hyperthyroidism, is an intoxication associated in many cases with goiter and in all cases with disturbed thyroid function. It is a relatively acute condition, occurring chiefly in women, especially about the age of thirty. In a classical sense the disease is characterized by a symptom-complex: *Exophthalmos*, *tachycardia*, *tremor* and *goiter*. This complete syndrome is not present by any means in all cases, many variations and incomplete forms being observed according to the de-

gree of intoxication and the tissues selected by the toxins. Thus, certain cases manifest only tremor and tachycardia, while others may show exophthalmos and goiter. The order of onset varies exceedingly, so that early cases present many difficulties in diagnosis. Some are inaugurated with cerebral symptoms; many with abnormal cutaneous sweating and flushing; others with tachycardia; and a large proportion with nervousness. Plummer cites the following sequence in the average case: (1) Cerebral stimulation, (2) vasomotor disturbances of the skin, (3) tremor, (4) mental irritability, (5) tachycardia, (6) loss of strength and weight, (7) cardiac insufficiency, (8) exophthalmos, (9) diarrhea, (10) vomiting, (11) mental depression, (12) jaundice and (13) death.

The so-called cardinal signs have certain essential qualities. In regard to the eyes, in addition to the proptosis and the consequent staring expression (*Stellwag's sign*), we find other definite signs: The palpebral fissures are widened, constituting *Dalrymple's sign*; upon following the examiner's finger downward the upper lids lag behind, a band of white cornea intervening between the margins of the lid and iris (this being known as *von Graefe's sign*) and *Möbius's sign*, or convergence inadequacy when attempting to accommodate for near points, is usually evident. Many patients with hyperthyroidism have no signs whatsoever referable to the eyes.

The heart, in the early stages, merely shows some acceleration of its rate without alteration of rhythm. Soon the patient becomes cognizant of its rapid beating, and, later, various degrees of irregularity and decompensation arise, such as dilatation, murmurs, skipped beats and fibrillation. The blood-pressure is often raised a few points. Goiter is usually present but rarely is it of sufficient size to produce pressure symptoms. The enlargement is commonly symmetrical, involving the entire gland; is very firm in consistency and is smooth in contour, although it may be nodular. A palpable systolic thrill over the gland is characteristic and a bruit is usually heard. At times the gland is not enlarged clinically, while occasionally it can only be palpated after persistent efforts. Frequently the entire gland pulsates visibly and forcibly.

Tremor is displayed best in the outstretched fingers. It is usually of a firm, rapid type, rather than of a coarse, slow character; yet the latter does occur.

Patients with Graves's disease are nervous and restless in the early stages. They perspire easily and have repeated "hot flashes" or flushing of the face. Often they have palpitation or are conscious of skipped beats or other alterations of the cardiac rhythm. Soon, loss of weight and strength follow, *metabolism* being seriously disturbed. Exophthalmos and goiter may appear at any time or both may be absent. Peevishness, irritability and mental instability follow the original restlessness; depression or actual melancholia often ensues.

Gastro-intestinal disturbances are late in the course of the disease, as is nephritis. Jaundice is not common. When present it may be associated with ascites. Menstrual disturbances occur with marked frequency.

All gradations of toxemia may be found. The course may be most acute, with marked debility and evidences of a severe intoxication; while other cases are more gradual in progression. The combination of any two or more of the cardinal symptoms of the disease with some of the minor symptoms will make the diagnosis. The Goetsch adrenalin test has no distinctive value, as positive reactions are ob-

tained in many individuals who are free from thyrotoxicosis. Pronounced metabolic disorders other than loss of weight are pronounced by Graves's disease, particularly the rapid types. These include glycosuria, diabetes and changes in the composition of the blood. In the fulminating types there is a veritable acidosis. Grave psychologic disorders occur in some patients. A most acute and violent delirium resembling very strongly that of alcoholism may be seen, especially in the latter stages of the disease.

Thyrotoxic goiter in its greatest degree of development, is the exophthalmic goiter. As previously mentioned, many patients have symptoms referable to hyperfunction but the composite of their histories falls short of true Basedow's disease. Any goiter accompanied by symptoms attributable to overaction of the gland, then, is a thyrotoxic goiter. The term, however, is usually limited to that class of goiters in which the cardiac symptoms are foremost—palpitation, tachycardia, perhaps arrhythmia. Shortness of breath is frequent and there may be edema of the lower extremities. Phenomena of nervous origin may be added to the cardiac symptoms but remain insignificant. Thyrotoxicosis of this nature may complicate an erstwhile simple parenchymatous goiter, a colloid goiter or other forms. If hyperthyroidism progresses, the condition merges into the state of Basedow's disease. (The term thyrotoxic goiter applied to a state of hyperthyroidism in which heart symptoms are preponderant.) It is most apt to be associated with an adenomatous thyroid. The course in thyrotoxic goiter is chronic, while that of exophthalmic goiter is relatively acute.

Accessory Thyroids and Parathyroids

Accessory thyroids and parathyroids are occasionally met with. The former may be found in the midline of the neck near the hyoid bone, or may be situated laterally. The most frequent site of an accessory parathyroid gland is in the superior carotid triangle, at the level of or above the hyoid bone.

Accessory thyroids may be found in various anatomic situations, principally (a) in the neck, (b) in the tongue, (c) within the thorax, (d) in the ovary.

(a) In the neck, accessory thyroids usually appear in the midline as small, rounded, cystic or solid tumors, which may or may not be attached to the thyroid gland. Their location is most often within some portion of the embryonic thyroglossal duct. Rarely they occur lateral to the thyroid cartilage. (b) Accessory thyroid tissue may exist in the tongue. Frequently it appears as a nodule at the base of the tongue near the foramen cæcum. (c) Again, thyroid tissue may present in the mediastinum or pleura, or (d) within the ovary. Accessory thyroids are supplemental to the true thyroid, as a rule, but it is important to remember that the "accessory" thyroid in some individuals is actually an aberrant thyroid and is the only accumulation of thyroid tissue in the body.

Accessory Parathyroid Cysts

These are exceedingly rare and always small in size and deep seated. The most frequent site is in the superior carotid triangle, at the level of or above the hyoid bone.

Thyroid Bursa

The thyroid bursa may become enlarged, forming a cystic swelling in the neck. Such a swelling appears in the midline of the neck, either above or below the hyoid bone, or over the thyroid cartilage. It is intimately adherent to either of these structures, although not attached to the overlying skin. In size it is rarely larger than an olive. If infection is present, the cyst is painful and tender. Upon swallowing efforts, the bursa moves upward with the larynx. It may thus be observed that from clinical characteristics an enlarged thyroid bursa cannot be absolutely differentiated from thyroglossal duct cysts or those of accessory thyroid glands.

Dermoid Cyst

These are very rare. They are firmer in consistency than is a hydatid or adenomatous cyst.

Hydatid Cyst

This is a very rare affection of the thyroid gland. It might be diagnosed by examination of the aspirated contents, but that procedure is hardly justifiable when dealing with the thyroid. From a clinical viewpoint, the cyst is not to be differentiated from other cystic conditions, since the diagnostic thrill on palpation has never been observed in an echinococcus cyst of the thyroid.

Teratoma and Mixed Tumors

These tumors are clinically identical and are most uncommon. Only eight cases of teratoma have been reported in the literature. Histologically they are *osteochondro-adenomata* and *osteochondrosarcomata*, the teratomata containing rudimentary organs in addition. They occur mostly in women and in old age. The *malignant types* grow rapidly and give rise to metastases, while the benign types are of a slow growth. They are very irregular, hard and nodular, in general, but alternate firm and soft areas may be made out. Their size may approximate that of a grapefruit or even exceed it. Pressure symptoms obviously rise with the larger growths.

Malignant Goiters.—The chief forms of malignant goiter are sarcoma and carcinoma. Malignant mixed tumors, endothelioma and perithelioma also occur but are rare.

Sarcoma, perithelioma and endothelioma are identical from a clinical standpoint, and for convenience only *sarcoma* will be described. Any type of sarcoma may arise within the thyroid gland. In contrast with carcinoma, it usually begins at an earlier age, especially between thirty and forty; it is softer in consistency, more regular, grows more rapidly and shows less tendency to involve the skin. At the onset one or both lobes are affected. The gland is first movable but later becomes adherent and fixed. Metastases take place to the lungs, skull and bones, as in carcinoma.

Carcinoma is by far the most frequent malignant tumor of the thyroid gland and arises particularly between the ages of forty and sixty, although it has been observed in comparatively young people. There are two features of paramount

importance in relation to its incidence. The first of these is that *90 per cent of carcinomata develop within a preëxisting goiter*. The second fact is that there are no clinical evidences of malignancy in an early carcinoma of the thyroid, since its origin is within the glandular structure. When the growth has progressed, and the capsule has become involved, with subsequent adherence to and infiltration of surrounding tissues, both subjective and objective symptoms manifest themselves. The earliest appreciable finding is an irregular nodule. The disease follows an acute or subacute course. Most often the tumor grows rapidly, becomes hard and irregular, and invades adjacent organs so that the enlargement becomes fixed and immobile. *Even the deglutitory motion of ordinary thyroid swellings may be lacking*, and adherence to the skin prevents movement of that tissue over the growth. Pain is usually marked. Hoarseness is particularly suggestive of malignancy and is brought about by recurrent laryngeal nerve paralysis. The trachea and esophagus become altered in shape and are frequently displaced from the median line. Coincident with their involvement, dyspnea and dysphagia appear, or are made worse if produced by the previous benign goiter. In the course of the disease the cervical lymph-nodes in the submaxillary, supraclavicular and carotid sheath regions are secondarily affected. The common carotid artery is displaced backward by most carcinomatous goiters, but now and then it is embraced within the infiltration. This is most likely to be present in the acute type which sometimes spreads widely and rapidly, including all the structures with which the thyroid is in relation, forming a dense, indurated mass. It is this type which so closely resembles "woody" thyroiditis, from which it may be impossible to make a differentiation. Carcinoma of the thyroid is apt to metastasize to the lungs, long bones and skull, fairly early in its course. Latent carcinoma also occurs, metastasis taking place before any changes can be observed.

It would seem reasonable, then, *to regard every goiter as potentially malignant*. Any sudden increase in size of a goiter in a middle-aged person will then be viewed with suspicion, whether or not the physical findings are suggestive, since the stage at which the disease is clinically diagnosed is a relatively late one. If pain, either local or neuralgic, accompanies an enlarging goiter, the possibility of malignancy is emphasized.

Hypothyroidism

Hypothyroidism, or deficient thyroid function, is directly opposed in its clinical manifestations to hyperthyroidism. It may be either congenital or acquired, and is associated with the absence or atrophy of the thyroid gland. As has been previously noted, hypothyroidism may arise in the presence of a goiter, but this is very exceptional.

The disease reacts somewhat differently at different periods of life, but, on the whole, the physical and mental changes induced are analogous. The absence of myxedematous tissue in the cretin is noteworthy, whereas its presence in adult hypothyroidism is of diagnostic import.

There are two particular forms of hypothyroidism according to the age of the patient: (a) Cretinism in the infant and child; (b) myxedema in the adult.

Cretinism.—There are certain differences which distinguish cretinism from a thyroidism. In brief, skin changes are less marked in endemic cretinism while bony

changes are more evident. Infants with a congenital absence of the thyroid gland seldom survive more than two or three years, though some may live even to old age.

Endemic cretinism is more common in males than in females. The cretin is short in stature, with a head which is disproportionately large. The skin is dry and harsh, but myxedema is absent. The features are stupid, expressionless, the tongue may protrude from the mouth, and the mentality is considerably below normal. In some cretins the mental powers are active despite the physical handicap.

Myxedema, or adult hypothyroidism, is seen mostly in women. It may arise spontaneously or occur after complete thyroidectomy, the latter being a rarity at the present time. Spontaneous myxedema starts particularly between the ages of thirty and fifty, and, like infantile hypothyroidism, may follow an acute infectious disease, such as typhoid fever. The disease is very gradual in its onset, slow in progression and chronic in its course which may be prolonged for thirty or forty years. The first noticeable symptoms are gradually increasing physical weakness and mental lethargy. These patients avoid every exertion or force themselves to do necessary tasks. Changes in the skin and subcutaneous tissues arise later. The skin becomes dry and scaly, loses its normal luster and is prone to eruptions. A flush over the malar prominences is quite characteristic, contrasting sharply with the muddy or pasty skin. Simultaneously, the facial features lose their mobility, the expression becomes stupid and is rarely altered, the cutaneous wrinkles are deepened and exaggerated. Mental alterations such as irritability, sluggish cerebration, slow speech and impairment of memory develop. The hair is sparse, especially over the pubis and in the axillæ. A very striking feature is the presence of pads of myxedematous tissue in the supraclavicular fossæ, sometimes the back of the neck and abdomen as well. The spadelike hands, with short rounded fingers, are almost diagnostic, while deformities of the feet are also rather frequent. In contradistinction to Basedow's disease, the pulse is slow and full.

The thyroid gland is hardly ever palpable, but myxedema may arise in the presence of an atoxic goiter, or it may ensue after a long-continued, "burned out" exophthalmic goiter.

CHAPTER VI

THORAX

INJURY OF THORAX

Thoracic Wall Injuries

Wounds of chest wall
Contusions of chest wall
Rupture of muscles of chest wall
Injury of the breast
Fractures of the bony thorax, including fracture of ribs, clavicle and sternum
Dislocations of sternum and clavicle

Intrathoracic Injuries

Injury of pleuræ
Injury of the lungs and bronchi
Pulmonary hernia
Traumatic asphyxia
Injury of the heart, pericardium and great vessels
Injury of the esophagus
Injury of the thoracic duct

History

Ascertain as well as possible the complete history of the accident, including: When and how injury was received, treatment primarily instituted, hematemesis or hemoptysis; type of weapon used, if any. Pain, type and radiation, and exact location. Is it increased on breathing?

Physical Examination.—*Inspection.*—General condition of patient, including signs of shock, facial expression and color of mucous membranes. Type of breathing, including rate, abdominal, thoracic or both, excursions of nasal alæ. Presence of visible bleeding and source, such as gunshot or stab wound, crushed bones. Thoracic symmetry or asymmetry, including visible subcutaneous emphysema, signs of fracture or hematoma, “caved-in” chest wall. Site of apex beat. *Palpation*, to detect subcutaneous emphysema, presence of fracture or fractures, variations in tactile fremitus, friction fremitus, pulsations, including position of apex beat, thrill, palpable deformity. *Percussion* to detect abnormal dullness, flatness, tympany, hyperresonance. *Auscultation* to determine presence or absence of normal breath sounds, friction rub, râles, gurgling and succussion sounds. (Always think of possibility of pulmonary and diaphragmatic hernia.) *Aspiration* to ascertain type of effusion. *Radiographic examination.*

Thoracic Wall Injuries

Wounds.—These are of various types, *i.e.*, incised, lacerated, contused, puncture, and gunshot. It is incumbent upon the physician, when dealing with any wound or trauma of the thorax, to determine whether or not the effects of the injury are confined to the thoracic wall; if not, then the extent and nature of injury to the thoracic contents should be carefully estimated. As will be observed from the further discussion of thoracic injuries, the intrathoracic organs may be involved

not only in the presence of penetrating wounds which traverse the chest wall, but by explosions, crushings and similar forces. Hence, the nature of a chest injury is to be gauged not in terms of the particular injurious agent, nor by external evidences of trauma, but rather by a comprehensive survey of the potential effects of thoracic injuries in general, embracing therein structures within the bony framework as well as the various components of the chest wall itself.

Contusions vary in degree. In minor contusions, a pinkish blush of the skin may be noted; later, swelling and tenderness, and perhaps subsequent ecchymosis. When larger areas are involved, or the causative force has been more severe, the chest muscles are held rigidly fixed, breathing becomes abdominal, and there is more or less disturbance of respiratory efforts, with consequent cyanosis. Occasionally, respirations cease temporarily; the pulse is accelerated and the patient exhibits some degree of shock. Locally, pain is exaggerated by motions and pressure for some time after the receipt of the injury, so that the presence of fractured ribs must be eliminated.

Rupture of muscles of the chest wall may arise from either direct violence or from muscular exertion. Sneezing and strenuous lifting often bring about this condition. The muscles most frequently involved are the pectorals, serratus and latissimus dorsi; the usual points of rupture are at the chest wall attachments. At times there may be a visible and palpable change of contour of the muscle, and a definite break or gap in the fibers may be felt. Quite frequently an hematoma obscures the palpatory findings; the forming of a diagnosis then requires tests of muscle function gauged according to the site of injury.

Injury of the breast occurs most frequently in females. In the male, this does not differ from a contusion of the chest wall, unless occurring at the time of puberty in a youth with mastodynia, in which case pain may be quite severe. Injuries to the female breast are often accompanied by severe pain, nausea and vomiting; even shock may be exhibited. Small hemorrhages frequently take place within the breast tissue, or a true hematoma is formed. Either of these conditions may become secondarily infected with the production of an abscess; or cyst formation may result; or reabsorption may occur without incident. Of special interest is the relation of trauma to breast tumors. For the most part, trauma must be considered as a coincidence, or may serve to attract attention to an hitherto unrecognized breast lesion; but it must be acknowledged that the scope of existing information does not warrant indiscriminate refutation of the potential rôle of trauma in the origin of tumors of the breast. In fact, the relation of injury to sarcoma, as a causative factor, has gained widespread credence.

An occasional sequel of breast injury is fat necrosis, the original trauma being followed by the appearance of an irregular, hard mass which may be mistaken for either a benign or malignant tumor.

Fractures of the Bony Thorax (see chapter on "Fractures and Dislocations").—These may be simple or compound, and occur with or without displacement of the bony fragments. In crushing injuries, displacement is often of such degree that the lung is penetrated by a rib, resulting in hemothorax. *Rib fractures*, when crepitus is absent, as frequently happens, are indicated subjectively by pain upon motion and deep inspiration, and objectively by point tenderness over the affected rib or ribs, together with localized pain at the site of fracture, when the ribs on the

affected side are "sprung," or compressed between the hands. Patients complain especially of pain upon lying flat in bed, and of difficulty in arising from a recumbent posture. Radiographs are usually positive.

Fractures of the clavicle are extremely common. They are usually easily recognizable by inspection and palpation and the impairment of pectoral or humeral muscle group function. Point tenderness is, of course, the most valuable sign in fractures of the clavicle without deformity.

Fractures of the sternum are infrequent, excepting when the force has been of a severe, crushing nature. The xiphoid process may be fractured without serious symptoms, but marked shock usually accompanies fractures of the manubrium and gladiolus. Patients exhibit dyspnea, rapid pulse, severe pain and oftentimes cyanosis, while the most dependable local signs are swelling and extreme tenderness over the sternum, with or without deformity.

Dislocations of the clavicle are frequent, while those of the *sternum* are rare. Dislocations of the clavicle, either sternal or acromial, can be seen and felt even in stout individuals. Those of the xiphoid process, also, are easily recognized. Dislocations of the manubrium upon the midpiece of the sternum are attended by great pain, dyspnea, cyanosis, and shock, because of pressure upon the great vessels, trachea or bronchi. Recumbency is practically impossible and symptoms are only slightly improved by adopting the sitting posture. The diagnosis can usually be made by careful palpation of the thorax.

Intrathoracic Injuries

The pleura may be *lacerated* by a penetrating wound, or by a fractured rib. If vessels of fair caliber are torn, hemothorax results, although this is more frequently seen in conjunction with a rupture of the lung. An acute pleurisy, with cough, pain upon breathing effort and a to and fro friction rub, may arise on a traumatic basis in the presence of a non-penetrating chest injury. The establishment of such a condition on a traumatic basis requires that the onset of symptoms should take place within twenty-four to thirty-six hours after the time of injury. Repeated examinations are always indicated.

The lungs may be *injured* by bullets, knife thrusts or other injuries causing penetrating wounds, and by means of fractured ribs with marked displacement of the fragments. The first signs are those of internal hemorrhage, quickly followed by clinical evidence of hemothorax or pneumohemothorax. A characteristic and diagnostic sign is subcutaneous emphysema, a crackling, crepitant sensation upon palpation of the skin, first manifested about the site of injury; later, this may spread over the entire thorax and into the neck. Infrequently, the point of lung rupture extends into the mediastinal surface, so that subcutaneous emphysema is delayed and first appears in the neck, the air traveling along the mediastinal prolongations of the cervical fascia. Cough, dyspnea and hemoptysis are common symptoms. Infection may take place along the penetrating wound or from within the lung itself, with the production of an empyema or lung abscess. A true pneumonia may occur, also, after a severe thoracic injury of any type, the traumatic origin being indicated by the relatively early onset of symptoms pointing to pneumonia.

The bronchi are rarely injured except in association with penetrating wounds which usually involve other structures, notably the great blood-vessels.

Pulmonary Hernia.—This condition occurs infrequently in severe thoracic injuries as when multiple fractures of the ribs have occurred, or when there has been a wide destruction of the chest wall, as in a shotgun wound. A portion or the greater part of the lung may herniate, so that a mass, covered by skin, is raised above the normal chest surface, heaving with the respiratory movements, crepitant upon palpation and accompanied by subcutaneous emphysema. Patients with such injuries are obviously in severe shock, with extreme dyspnea, pain and cyanosis. The mass is reducible by firm pressure and is often accompanied by hemothorax. A pulmonary hernia or pulmonocele may also occur some time after a penetrating injury, secondary to thinning and separation of the intercostal muscles. A constricting ring may be identified at the point of emergency of the lung through the chest wall. *Upon percussion*, a pulmonary hernia is resonant, and vesicular breathing is heard *upon auscultation*.

Traumatic Asphyxia.—This is an unusual affection arising after a chest injury, and is characterized by a deep bluish or reddish-purple discoloration or cyanosis of the upper part of the chest, the neck and face. The initial appearance, as a rule, is some time after the injury, and asphyxia may occur without prominent pulmonary symptoms such as dyspnea and orthopnea. It is seen in association with severe compression injuries, as when a man is pinned beneath a heavy weight for some time, limiting respiratory efforts and depriving the body of the proper amount of oxygen. Ecchymosis occurs in the skin of the affected regions, the conjunctivæ and, at times, the brain and lungs. Optic nerve atrophy is a serious complication.

Injuries of the Heart and Pericardium.—See “Injuries of Heart,” page 178.

Injuries of the great vessels are rapidly fatal and may be inferred by the site of external wound and the apparent course that the missile has taken.

The esophagus is seldom injured alone, coincident injuries of the lungs and mediastinal organs occurring. The vomiting of blood in the presence of a thoracic injury is the only suggestive sign, investigation by means of radiography and the esophagoscope not being practical because of the serious nature of such injuries.

Thoracic Duct.—See “Mediastinum.”

AFFECTIONS OF THE THORACIC WALL

(*Injuries Not Included*)

Inflammatory conditions	{	acute	{	diffuse furunculosis
				furuncle
				diffuse cellulitis
				pyogenic osteomyelitis
				typhoid osteomyelitis
		chronic	{	pyogenic abscess
				pyogenic osteomyelitis
				typhoid osteomyelitis
Granulomata	{	syphilis		
		periostitis		
		gumma		
		tuberculosis		
		actinomycosis		

Aneurysm

Pulmonary hernia

Echinococcus cyst

Tumors	{	benign	{	fibroma
				lipoma
				papilloma
				pigmented mole
				neuroma
				hemangioma and lymphangioma
				osteoma
				chondroma
				dermoid cyst
				sebaceous cyst
		malignant	{	carcinoma (type depending upon original tumor but epithelioma may be primary here)
				myeloma
				chloroma
				sarcoma (all types)

History

Age; Sex; Occupation

Family History.—Tuberculosis, cancer and other tumors, syphilis.

Personal History.—Complete venereal history; tuberculosis, acute infectious diseases (especially typhoid and pneumonia), with dates. Cough, hemoptysis, night-sweats. Date of onset and character; dyspnea; pain, character and radiation. Injury.

Physical Examination.—Site and general appearance of part involved. Presence and location of sinus and whether multiple or single. If mass is present, is it attached to skin? Its contour, consistency and apparent origin. Pain on manipulation. Signs of acute inflammation about involved area. Condition of bone on probing and appearance of discharge and examination of same. Bruit or thrill. Radiographic examination, especially with bismuth; leukocytes, Wassermann, Widal, sputum. Thorough examination of lungs. Temperature and pulse.

INTERPRETATION OF HISTORY

Age

Infancy { hemangiomata
pigmented moles
syphilis

Childhood { acute pyogenic osteomyelitis
sarcoma
tuberculosis

Early Adult Life { acute typhoid osteomyelitis
acute diffuse furunculosis
chloroma
myeloma
osteomyelitis
sarcoma
sebaceous cysts
tuberculosis

Adult Life { actinomycosis
aneurysm
benign tumors
carcinoma
syphilis

Sex

Male { acute inflammatory conditions
actinomycosis
aneurysm
pulmonary hernia
sarcoma
syphilis

Female { carcinoma, especially

Occupation

Farmers { actinomycosis

Laborers { pulmonary hernia

Personal History.—*Venereal History.*—Syphilis and aneurysm.

Acute Infectious Diseases.—The acute inflammatory conditions, including typhoid osteomyelitis.

Cough, Hemoptysis, Night-Sweats.—Tuberculosis or diseases advanced to such a degree as to cause mediastinal or pulmonary symptoms.

Dyspnea.—A sign caused by encroachment or invasion of a thoracic affection involving lungs or mediastinum.

Pain.—A symptom caused by pressure, irritation or involvement of one or more nerves. Especially found in myeloma, the inflammatory conditions, large benign tumors and in the advanced stages of malignant tumors and aneurysm.

Physical Examination.—*Presence of Sinus.*—Chronic pyogenic osteomyelitis, typhoid osteomyelitis, tuberculosis, actinomycosis, advanced gumma, malignant condition with degeneration.

Is Mass Attached to Skin?—Showing whether skin is involved by an inflammatory process or invasion. Fixity often a late symptom.

Skin Movable

Usually benign tumors

Early sarcoma

Early secondary bone carcinoma

Aneurysm

Skin, Fixed

Usually in the inflammatory conditions

Malignancy

Aneurysm with degeneration and ulceration of soft tissues

Granuloma in later stages

Bruit or Thrill.—Aneurysm, or tumors situated over large vessels.

Wassermann.—Syphilis.

Widal.—Typhoid osteomyelitis.

Sputum.—Tuberculosis—perhaps actinomycosis.

Inflammatory Conditions

Acute Diffuse Furunculosis.—This condition is common, occurring most especially over the scapular region. It is manifested by small and perhaps very large boils, tender to the touch, which if allowed to progress without treatment, may break down, forming small and large areas of induration extending deeply into the subcutaneous and perhaps muscular tissues, and from which may ooze a thick purulent material. Diabetes is at times a causative factor.

Furuncle.—See chapter on "Infections."

Acute diffuse cellulitis is an extremely serious, and at times fatal, purulent inflammation of the soft tissues of the chest, involving the subcutaneous fat, the muscles and the intermuscular connective tissue planes. The etiology is variable and includes abrasions of the skin, infection through the nipple or inflammatory conditions of the breast, infection within or about the axillary, cervical, supraclavicular, and infraclavicular glands and rarely in the course of the acute infectious diseases. The most common sites are beneath the pectoralis major, the latissimus dorsi and the subscapularis muscles. The symptoms are, as a rule, quite fulminating, including chills and fever, marked prostration, high leukocytosis and at times delirium; added to these are localized pain and tenderness, a fairly widespread induration, and occasionally areas of fluctuation within the areas of induration. The regional lymph glands are usually swollen and tender. Deep aspiration may localize pus.

Acute pyogenic osteomyelitis is usually situated in the anterior portion of the rib or sternum, perhaps in the clavicle, at or near the costochondral articulation. There is severe localized pain over the inflamed area. Constitutional symptoms are present, with leukocytosis. There may be a semifluctuating tumor over the involved bone, with redness of the skin. A sinus often accompanies this affection. This condition often follows wounds, typhoid fever, the acute infectious diseases and empyema. Acute osteomyelitis of the sternum is an extremely rare condition, but when it does occur it usually exhibits a violent train of symptoms, such as severe epigastric pain, high fever and often delirium. It may result from an empyema.

Acute typhoid osteomyelitis may, as a rule, be easily differentiated from the ordinary pyogenic conditions: The process is slower, less painful, with fewer signs of inflammation and the absence of leukocytosis and less severe constitutional symptoms. At times a secondary pyogenic osteomyelitis may veil the original infection. This condition is most commonly found at the costochondral junction. A history of a preëxisting or existing typhoid fever aids in the diagnosis as does also a positive Widal reaction.

Chronic Pyogenic Abscess.—When this condition presents, one should bear in mind the probability of an existing tuberculous process of a rib, a vertebra, the scapula or sternum, though a tuberculosis within the thorax should not be overlooked as a possibility. The abscess formed is generally of slow formation, usually painless, and without the signs of acute inflammation; it is fluctuant to the feel and varies in size. Sinus formation in this type is not present.

Chronic Inflammatory Conditions.—These represent long standing infections with a pertinacity of signs and symptoms.

Granulomata

Syphilis.—This condition is generally difficult to distinguish from tuberculosis of the chest wall. It manifests itself by a syphilitic involvement of the *periosteum*, which, as the process extends, becomes a definite osteomyelitis. It occurs in the later stages of syphilis as a more or less diffuse, spindle-shaped enlargement of the rib; or, if it involves the sternum, as a definite, more or less circumscribed tumor mass, later on becoming soft and fluctuant. This tumefaction finally breaks down into a *gummatous ulceration* with multiple sinus formation, from which exudes a thick, dirty white, homogeneous discharge. The disease is quite painless, though cases are on record in which marked sensitiveness over the site of the lesion has been present. Other manifestations of the disease may lead toward the forming of a correct diagnosis. The condition responds rapidly to antisyphilitic treatment.

Tuberculosis.—Tuberculosis of the chest wall is a fairly common condition, and is usually associated with pulmonary tuberculosis or tuberculosis elsewhere in the body. It is extremely rare as a primary lesion in the chest wall. It occasionally follows injury and is found more often in middle life than in children, though no age is excepted. The most common sites are at the costochondral junction, the chondrosternal joint and the cartilage. It should be remembered that the manifestation of the disease may be at a distance from the primary focus, and that the exhibiting lesion may be found in any part of the thoracic wall, anteriorly, laterally or posteriorly.

The affection is slow and insidious in its course and may be noticed by the patient only after it has advanced to an abscess formation: the lone presenting symptom being a "swelling on the chest." It begins as a thickening of the periosteum or cartilage, developing into a somewhat soft, oval swelling, with the absence of acute inflammatory signs. Pain and tenderness may or may not be present, and the temperature may be normal or only slightly elevated.

The constitutional symptoms depend to a great extent upon the severity of the infection of the primary focus. As the disease progresses, an abscess forms and readily breaks down, presenting single or multiple sinuses with indurated, infiltrated walls covered with soft or caseous material. Probing will usually elicit roughened bone at the base of the sinus.

Actinomycosis.—Actinomycosis of the skin and subcutaneous tissues of the chest wall is secondary to pulmonary and mammary gland actinomycosis. Its course is very chronic and is characterized by the formation of single or multiple abscesses, covered with a brawny, infiltrated skin through which multiple areas of softening may be noted. Sinuses with indurated walls, from which exude the characteristic yellow granules, are present. The usual acute inflammatory signs are absent, and pain and tenderness, if present, are not severe.

Aneurysm

The presence of an aneurysm of the arch of the aorta must always be considered as a possibility when dealing with thoracic wall tumors. It presents as a small or large prominence over the upper portion of the sternum or just laterally to it. The condition usually occurs in middle adult life or old age, and most often

in a syphilitic. The symptoms are those which accompany an aneurysm elsewhere, such as an expansile pulsation, thrill and a distinct murmur on auscultation. In its later stages, an aneurysm may be confused with a thoracic wall abscess in as much as the skin may be hard, brawny, indurated and even ulcerated.

Radiographic and fluoroscopic examinations will confirm the diagnosis.

Pulmonary Hernia

Pulmonary hernia may present as an oval, elastic swelling most frequently found in the anterior intercostal spaces and near the costochondral junction. It may follow direct trauma or violent attacks of coughing. It is reducible, giving rise to a crackling, crepitant sound. Vesicular breathing may be heard over the site of hernia, unless the lung has become strangulated. See under "Injury of Thorax."

Echinococcus Cyst

This is such a rare condition that it is simply mentioned as a vague possibility. It has been reported as a disease manifesting itself by cystic formation from which, on aspiration, are obtained the hooklets. Secondary infection of the cyst has occurred.

Tumors

These are divided into (1) those originating from the soft tissues; (2) those from the bony thorax; and (3) those originating from within the thorax. This latter group has been considered in the last part of the chapter on "Mediastinum."

GROUP I

<i>Benign</i>	<i>Malignant</i>
Fibroma	Carcinoma
Lipoma	Sarcoma
Papilloma	
Pigmented moles	
Neuroma	
Hemangioma	
Lymphangioma	
Osteoma	
Chondroma	
Dermoid cysts	
Sebaceous cysts	

GROUP II

<i>Benign</i>	<i>Malignant</i>
Osteoma	Carcinoma
Chondroma	Myeloma
	Chloroma
	Sarcoma

Symptom	Tuberculosis	Syphilis, Periostitis and Gumma	Actinomycosis
Age	Childhood and early adult life.	Infancy and adult life.	Adult life.
Course	Chronic.	Chronic.	Chronic.
Site	Costochondral and chondrosternal junctions.	Ribs and sternum.	Soft tissues.
Pain	Present or absent.	Present in periostitis.	Usually absent.
Description	Brawny, semifluctuant or fluctuant swelling, later with changes in overlying skin and sinus formation surrounded by granulation tissue. Probe introduced into sinus shows bone destruction.	In periostitis, thickening, later becoming semifluctuant or fluctuant, overlying skin showing evidences of invasion. In gumma, rather soft firm swelling, later on breaking down, skin showing evidences of invasion. Perhaps sinus.	Skin becomes of a bluish red color; sinuses are usually multiple with presence of induration and ulceration of overlying skin. Usually yellow pus.
Special data	Other signs of tuberculosis present. Lung usually involved. Radiography.	Positive Wassermann. History. Therapeutic reaction.	Sulphur granules in discharge. Grain handlers.

BENIGN

Fibroma appears as a single or multiple, slow growing, symmetrical tumor of the chest wall. When found alone it is hard, oval, deep seated and therefore but slightly movable, with no invasion of the skin or subcutaneous tissues. When multiple, they are more apt to be soft (though they may be hard), freely movable, painless tumors with no tendency toward skin invasion.

Lipoma may be pedunculated or appear as a diffuse growth beneath the skin, varying in size from a small to a large mass, freely movable, slow growing, painless, soft and elastic and lobulated to the feel. They are commonly found between the scapulae in the shoulder and axillary region, though they may grow on any part of the thoracic wall.

Papilloma occurs as small or large pedunculated, generally pigmented outgrowths from the skin, *non-sensitive*, but at times showing ulceration or infiltration

AFFECTIONS OF THE THORACIC WALL

Aneurysm	Pulmonary Hernia	Benign Tumors	Malignant Tumors	Symptom
Adult life and old age.	Any, especially adult life.	Congenital; adult life.	Carcinoma, adults and old age. Sarcoma, young adults and adults.	 Age
Slowly progressive.	Sudden onset, usually rapid.	Slow growing.	Rapid or fairly rapid.	 Course
Sternum or lateral to same.	Anterior chest wall between ribs.	Of soft tissue origin, all regions. Of bony origin, ribs, costochondral junctions. Sternum.	Skin, breast or bone (carcinoma). Soft tissues or bone (sarcoma).	 Site
Usually present.	Present or absent.	Usually absent.	Usually absent until nerve-centers involved.	 Pain
Bulging of anterior chest wall which usually shows an expansile pulsation. Overlying skin tense, shiny, often reddened. Tenderness absent or slight. Bruit and thrill.	Oval or rounded, reducible mass soft and crepitant. Vesicular breath sounds present.	In general, circumscribed non-tender and movable. Moles, lymphangiomas and hemangiomas pigmented. Consistency soft or firm. At times pedunculated. If of bony origin, hard, fixed, usually regular, oval or rounded.	If carcinoma, hard or soft, fixed, irregular, and skin often shows signs of invasion. At times ulcerated. Usually somewhat tender. If sarcoma, hard or soft, fixed more or less regular, early invasion of the skin. Ulceration common. Often spindle-shaped.	 Description
Radiography. Wassermann reaction. History. Other signs of aneurysm.	Injury. Violent coughing.	Lymph- and hemangioma, congenital.	Carcinoma "en cuirasse" often noted.	 Special data

about the base. When the latter conditions exist malignancy should be seriously considered.

Pigmented Mole.—This condition at times is described as a brown or brown-purple, flat or almost flat discoloration of the skin which may remain stationary, or at any time show a tendency to increase rapidly in size, infiltrating the skin, as it were, and assuming a sarcomatous or carcinomatous degeneration.

Neuroma appears as a small, movable, fairly hard, very sensitive tumor. It is rare, and, when present, is situated along the course of a nerve.

Hemangioma.—This appears as a congenital tumor and may be of the flat or elevated type. When flat it appears as an ordinary nevus or "birth-mark," varying in color from light red to dark purple. The elevated type appears usually as a nodular, tortuous mass, the nodules being soft to the touch and easily compressible; the mass may show a colored overlying skin or the cutaneous surface may be

entirely normal in color. The growths are as a rule slow growing, though they at times may progress rapidly in size.

Lymphangioma.—These true lymph-vessel tumors are rare and may appear as definite nodular masses, soft and spongy to the feel and at times compressible. The skin over the mass is usually of normal appearance and may not be attached. On the chest wall they are most frequently found in or about the axillary region.

Osteoma is rarely found on the thoracic wall. It may follow injury or an ossification of a preëxisting chondroma. It appears as a hard, regular, fixed mass, small or large in size. The overlying skin is freely movable and there is no pain unless the growth becomes so large as to cause concomitant pressure symptoms.

Chondroma.—This tumor is frequently found, and, when present, is usually noted at a costochondral junction, or at the junction of the gladiolus with the manubrium or xiphoid process. This condition often follows injury and is characterized by a hard, regular, immobile swelling with little or no pain (unless the growth impinges upon a nerve or encroaches upon the mediastinum).

Dermoid and sebaceous cysts appear as small or large, freely movable, regular, painless masses with no attachment to the skin or underlying tissues. The tumors are essentially fairly hard to the feel, though a sense of elasticity is often present. In the later stages, if secondary infection takes place, signs of inflammation together with a breaking down of the tissue may occur, in which case the skin then becomes involved.

MALIGNANT

Carcinoma appears as a primary and as a secondary disease. In the former condition it develops as a slowly growing epithelioma with little tendency toward invasion of the deeper tissues. A papilloma, however, if it undergoes carcinomatous change may grow rapidly, infiltrating the base and surrounding tissues and rapidly ulcerating. When secondary, it usually follows a carcinoma of the breast and may assume the diffuse boardlike infiltration of the skin and deeper tissues ("*cancer en cuirasse*"), or as a formation of multiple, hard, small nodular masses with a tendency toward coalescence. Diffuse deep ulceration of the thoracic skin may occur in a carcinomatous process.

Myeloma very rarely affects the ribs and sternum of the chest wall. It is usually found in young adults. It is a slow-growing, usually regular swelling, expanding, as it were, the bone itself. Other bones of the body are affected. The disease is usually accompanied by neuralgic signs in the part affected and the appearance of Bence-Jones bodies in the urine. Spontaneous fracture of the affected rib may take place.

Chloroma is a very rare systemic disease, at times including the ribs and sternum, and characterized by a rapid, more or less regular, bony growth with a tendency toward surrounding tissue invasion. Other bones of the body are involved and an acute fever, hemorrhagic diathesis and severe constitutional symptoms appear, as in the acute leukemias. The blood-picture is one of an acute leukemia. On cross section the growth is seen to be colored.

Sarcoma.—Primary sarcoma of the skin and primary sarcoma of the periosteum or true bone substance of the ribs and sternum are rather common tumors of the chest wall. The latter condition is found more frequently than is the former.

Sarcoma of the skin generally follows a degeneration of a pigmented mole, is usually of the melanotic type and is characterized by its rapid growth, very firm consistency and tendency to early infiltrate the neighboring tissues. They may appear as solitary or multiple nodules.

Sarcoma of the bony thorax is most malignant when emanating from the periosteum and is found as a rapidly growing tumor mass, hard or soft (depending upon the extent of the process), fixed to the underlying tissues (rib or sternum), with at first movable skin over tumor site, which later becomes attached. Ulceration is of frequent occurrence and invasion of the pleura and adjacent structures takes place. As the disease progresses, pain becomes an important symptom.

Sarcoma originating from the true bone substance of the rib or sternum is less rapid in its course and may take on the form of a fusiform, spindle-shaped, slowly growing swelling, which if not removed early, gradually assumes the clinical picture of a deep-seated malignant tumor of the thorax, with the accompanying thoracic signs such as pain, dyspnea, obliteration of a part of the mediastinum, cough, etc.

In all cases, radiographic examinations should be made.

AFFECTIONS OF THE AXILLA

Traumatic conditions	{	hematoma		
		edema		
Inflammatory conditions	{	acute	{diffuse cellulitis	
			acute multiple furunculosis	
			acute pyogenic lymphadenitis	
			acute furuncle	
			abscess	
		chronic lymphadenitis		
Granulomata	{	tuberculosis	{acute lymphadenitis	
			chronic lymphadenitis	
		syphilis		
		actinomycosis		
Benign hypertrophy and hyperplasia				
Hodgkin's disease	{	acute		
		chronic		
Lymphatic leukemia	{	acute		
		chronic		
Aneurysm				
Tumors	{	benign	{angioma	
			chondroma	
			fibroma	
			lipoma	
			myxoma	
		malignant	{	
			sarcoma	{lympho-
				melanotic
				myxo-
				round cell
				spindle
			carcinoma	{epithelioma
				other types depending upon type of original tumor
Axillary mamma				

History

Age; Sex

Family History.—Tuberculosis, cancer or other tumors, blood diseases, enlarged glands, syphilis.

Personal History.—Injury, acute infectious diseases, tuberculosis or syphilis. Infection of hand or arm, distal to axilla. Tonsillitis, mucous membrane bleeding, respiratory difficulty. Former breast operation and dates.

Present Illness.—Onset and character. Pain, character and radiation; known cause for extending inflammation, *i.e.*, abrasion, pimple or boil. Chills or fever. Examination of body lymph glands; signs of inflammation about axilla, arm, or hand; condition of skin over affected area. Location. Consistency, contour, mobility, discreteness, or confluence of parts involved. Presence of sinus. Pain on pressure. Bruit or pulsation. Examination of lungs, liver and spleen; blood-count, Wassermann. Examination of discharge.

INTERPRETATION OF HISTORY

Age.—*To Puberty.*—Tuberculosis, angioma and hypertrophy and hyperplasia, acute pyogenic lymphadenitis.

Young Adult.—Syphilis, Hodgkin's disease, tuberculosis, actinomycosis, acute and chronic inflammatory conditions, benign tumors, sarcoma.

Adult.—Syphilis, Hodgkin's disease, sarcoma, carcinoma, leukemia, benign tumors.

Advanced Age.—Sarcoma, carcinoma.

Sex.—*Male.*—Leukemia, syphilis, Hodgkin's disease, sarcoma, inflammatory conditions, especially acute lymphadenitis.

Female.—Carcinoma, chronic furunculosis.

Family History.—*Blood Diseases.*—Leukemia and Hodgkin's disease.

Personal History.—*Acute Infectious Diseases.*—Leukemia, Hodgkin's disease, acute diffuse multiple furunculosis, acute furuncle.

Injury.—Hematoma, edema, all inflammatory conditions.

Infection of Hand or Arm Distal to Axilla.—Acute pyogenic lymphadenitis, acute diffuse cellulitis, chronic lymphadenitis.

Mucous Membrane Bleeding.—Leukemia, Hodgkin's disease and syphilis.

Respiratory Difficulty.—As a rule, denotes an extension of an inflammatory condition or malignancy by invasion or metastasis.

Former Breast Operations.—Enlarged axillary glands often follow carcinoma, sarcoma, tuberculosis, and actinomycosis.

Traumatic Conditions

Hematoma usually follows an injury. It appears rapidly, as a tense or boggy, irregular, painful or painless mass, covered with a discolored skin varying from a pale to a deep brown purple. The mass is fixed and has a tendency toward confluency. Aspiration or puncture will bring forth fluid or clotted blood. The tendency toward rapid absorption usually contra-indicates aspiration.

Edema, as a rule, presents after an injury or inflammation, and at times follows breast operations. It is seldom localized in the armpit, but is generally seen extending from the hand and arm into the axilla; the swelling pits and is boggy on pressure. Pain may or may not be present. There is generally some causative factor.

Inflammatory Conditions

Acute diffuse cellulitis may follow an injury, and is often caused by boils or carbuncles, or is seen as an extension from an infection distal to the armpit; an axillary adenitis or abscess may extend deep into the tissue causing the above. It is usually characterized by an acute inflammatory condition of the skin and subcutaneous tissues, accompanied by a brawniness, tensity and induration. Pain on deep pressure and the characteristic subjective and objective signs of inflammation are present. At times, the reaction is so severe and so extensive as to cause death. The lymph glands become enlarged and painful.

Acute diffuse multiple furunculosis is of common occurrence, and may be trivial or may cause constitutional symptoms. The onset is, as a rule, acute, the multiplicity of the furuncles appearing shortly after the initial boil; scattered areas of ulceration within the furuncles, with areas of induration and with, perhaps, the presence of sinus, appear. The affection may assume a chronicity or may disappear within a few weeks. At times the lymph glands become enlarged and painful.

Acute pyogenic lymphadenitis usually follows an infection of the hand or arm distal to the axilla, though it may occur in the course of an acute diffuse cellulitis or furunculosis. The onset is acute, accompanied by an enlargement of the axillary glands, some of which may be extremely small, while others may be markedly enlarged. The glands are tense or fluctuant, depending upon the amount of degeneration, are regular, and in the early stages movable and discrete; marked pain is elicited on pressure. As periadenitis appears, the glands become more fixed and confluent. As the inflammatory process increases, the gland or glands become softer, and more fluctuant, and a sinus, discharging variable amounts of pus, presents.

Acute Furuncle.—See "Furuncle."

Abscess.—See "Abscess."

Chronic axillary lymphadenitis is caused by a sluggish and but slightly virulent, persistent infection distal to the armpit, and may be the result of an acute infection, drained by the axillary nodes over a long period, during which time the gland or glands take on a condition of more or less fibrosis. The glands are fairly hard, usually discrete, and are not tender on pressure. At times very mild grades of inflammation may be present about the enlargements.

Granulomata

Acute tuberculous lymphadenitis as a primary disease is rare; as a secondary affection it is quite common, and at times is difficult to diagnose. In making a diagnosis of an acute axillary tuberculosis, the history and the complete physical examination of the patient are important factors. The absence of pain and other

Symptom	Hematoma	Furunculosis	Acute Lymphadenitis	Abscess	Chronic Lymphadenitis
Age	Any.	Mostly adults.	Any.	Any.	E s p e c i a l l y adults.
Onset	Acute.	Acute and chronic.	Acute.	Acute.	Gradual.
Inflammatory signs	Absent, unless secondary infection.	All present.	Present.	Present.	Absent, as a rule.
General characteristics	Boggy, ecchymotic swelling. Later may be firm, due to clotting.	Single or multiple. Obstinate and often progressive.	One or more glands swollen. Usually tender, firm and painful.	Indurated skin overlying a fluctuant, tender mass. Fever and pulse raised.	One or more glands discrete or confluent. Enlarged and firm.
Special data ..	Follows injury; as a postoperative complication, from infection with necrosis of vessels. Aspiration often yields bloody fluid.	Often merges into a chronic process.	Usually follows a wound or abrasion, distal to glands affected. Is often attended with inflammatory streaks running up the arm.	This is a further stage of an acute lymphadenitis. Rarely, it is of tuberculous origin.	Usually there is a preceding acute lymphadenitis or distal persistent infection.

signs of acute inflammation may aid in the diagnosis; even in the acute stage a sinus, surrounded by a bluish, granulating tissue, from which exudes a thick pus containing tubercle bacilli, may occur.

Chronic Tuberculous Lymphadenitis.—The etiology is the same as in the acute type. The course is over a fairly long period of time, the presenting symptoms to the patient being, perhaps, drainage from the axilla, with a swelling; at other times, the painless swelling may be the only reason for calling one's attention to the condition. To the feel, the glands are hard or soft, usually regular, but fairly well fixed to the underlying tissues, and painless. When a sinus presents it is a typical "tuberculous sinus."

Syphilis appears in the secondary stage. The glands are usually fairly movable,

AFFECTIONS OF THE AXILLA

Chronic Affections of Lymph-Nodes	Aneurysm	Benign Tumors	Carcinoma	Sarcoma	Symptom
See "Affections of Lymph Glands."	Middle and advanced age.	Any.	Middle and advanced age.	Young adult and adult.	 Age
	Gradual or rapid.	Gradual.	Gradual or rapid.	Fairly rapid.	 Onset
	Absent.	Absent.	Invasion of skin causes redness and induration, at times.	Present, when invading skin. May ulcerate.	 Inflammatory signs
	Rounded or fusiform mass, firm or elastic, with expansile pulsation. Bruit and thrill. Decrease in size upon subclavian pressure; increased upon brachial pressure. Often painful.	Soft or firm. Single or multiple. Not tender. Freely movable. Circumscribed.	At first, one or more nodes are involved and are movable and painless. Later on they become fused and fixed. Nerve pains and edema of arm are common.	May be primary in a single node. At first freely movable. Rapidly becomes fixed with increase in size. As a secondary affection it appears the same as carcinoma. Ulceration is common.	.. General characteristics
	Wassermann reaction is often present. Blood-pressure often elevated. Nerve pains, common. Distal swelling and edema, common. May follow injury or arterial degeneration.	Lipoma and fibroma most common. Artery may pulsate beneath or above large benign tumor.	As a rule, secondary to carcinoma of breast.	May be primary or secondary. Early involvement of overlying skin and ulceration common.	.. Special data

discrete, painless and with no signs of inflammation. The history of the case and a positive Wassermann will establish the diagnosis.

Actinomycosis is a condition more rarely found than tuberculosis of the axilla. The discharge of yellow granules, with a sinus formation, together with a diffuse brawniness of the skin, are the main distinguishing features. At times, a clinical diagnosis from chronic tuberculosis is impossible.

Benign Hypertrophy and Hyperplasia

This condition is distinguished by a long-standing, multiple enlargement of the axillary glands, which are fairly soft, regular, mobile and painless, and show-

ing no tendency toward skin invasion. In most cases of this type other lymph-gland regions show the same condition of glandular enlargement.

Acute Hodgkin's Disease

Rapid enlargement of the axillary glands, with fever and perhaps chills, accompanied by glandular enlargements in other parts of the body, in a young person, is most suggestive of the above. In this type of case the glands are fairly soft, movable and discrete, with an entire absence of inflammatory signs. The spleen and liver may or may not be enlarged. Mucous membrane bleeding is common. Blood examination may show an increase in the eosinophilic leukocytes.

Chronic Hodgkin's Disease

This type is more often found in adult life, and is characterized by a chronic enlargement of the axillary and usually other lymphatic chains. Intermittent attacks of chills and fever, and a loss of weight, are usually present. The glands are at first fairly soft, but as the disease progresses they become of a stony hardness, fuse together and form a confluent mass. There are no evidences of pain other than that due to pressure. Dyspnea may be an important sign, caused by mediastinal invasion. Radiographic examination may show mediastinal involvement. The liver and spleen are enlarged. The blood-count may possibly show an eosinophilia.

Acute Lymphatic Leukemia

This type of leukemia usually shows the same train of symptoms as does the acute Hodgkin's disease with the addition of more severe and more frequent mucous membrane bleedings, and a marked leukocytosis of the lymph-cell variety of leukocyte.

Chronic Lymphatic Leukemia

This is often confounded with chronic Hodgkin's disease, but the marked lymphocytosis and the absence of lymph-gland coalescence easily distinguish the disease. The lymph-gland chains throughout the body are enlarged.

Aneurysm

Aneurysm of the axillary artery, at times, may resemble an enlarged gland. The onset may be rapid or slow, and the history of previous injury, syphilis, or alcohol may be present. Pain may not be severe, but it is more constantly present than in Hodgkin's disease or leukemia. The mass is elastic, fixed, regular or irregular, with an expansile pulsation, and with a distinct bruit. Pulsation ceases on pressure upon the subclavian artery.

Tumors

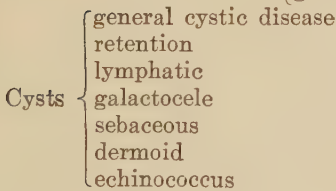
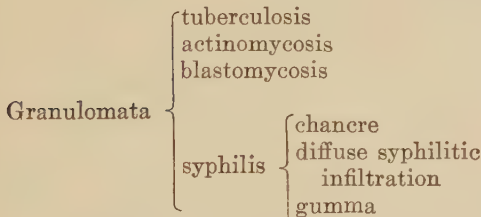
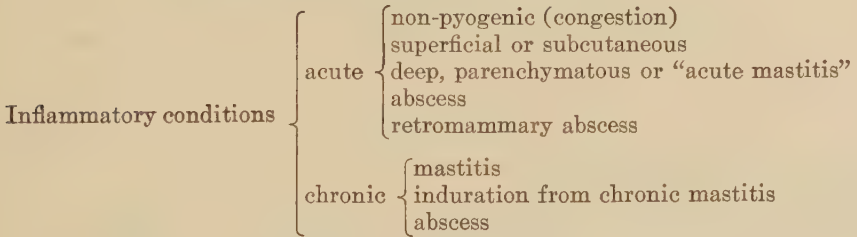
Benign (see "Benign Tumors").—It should be remembered that a tumor situated over the axillary artery may beat on palpation, and may at times give rise to a bruit. The pulsation is not of the expansile type. The most common of these are

the lipoma and fibroma. The myoma, chondroma and angioma may occur. The non-fixity of the mass is an important element in the diagnosis.

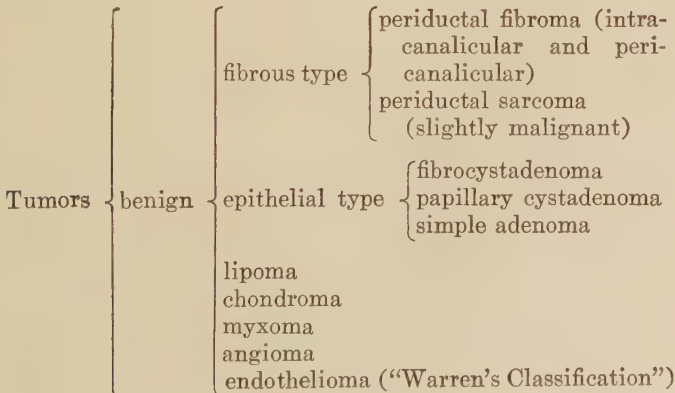
Malignant.—These are the sarcomata and carcinomata. The former are of all varieties, but when found within, or in the neighborhood of the axilla, are usually of the melanotic type, representing a sarcomatous change of a pigmented mole. Sarcomata may represent lymph-nodes, secondarily infected from regions which they drain, and which are affected with the disease.

Carcinomata of the armpit are usually secondary to carcinoma of the breast. At first they are movable, but gradually become fixed, often causing an edema of the hand and arm, by pressure upon the venous trunks.

AFFECTIONS OF THE BREAST



Hypertrophy



Tumors (<i>cont.</i>)	} malignant	adenocarcinoma medullary carcinoma scirrhus carcinoma carcinoma simplex gelatinous carcinoma carcinomatous cyst squamous epithelioma acute miliary carcinosis cystic or adenosarcoma sarcoma spindle giant mixed melanotic round cell alveolar myxosarcoma
Diseases of the nipple		{ Paget's disease syphilis

History

Age; Sex; Married or Single

Family History.—Tuberculosis, cancer and other tumors, syphilis.

Personal History and Present Illness.—Complete menstrual and marital history, including condition of breast during menstrual periods, such as appearance of nodes or swellings of breast during such times, and if growth is present, does it increase or subside during menstruation? History of pregnancies, and has patient nursed children? Condition of breasts during previous pregnancies. Is affection in any way connected with pregnancy? Date and character of onset (gradual or rapid) and trace the course of the disease up to present time. Chills, fever, cough or dyspnea. Are there remissions in enlargement of growth? History of previous or present discharge from the nipple, bloody or serous. Previous treatments. Pain; character and radiation. Injury. Loss of weight.

Physical Examination.—*Inspection.*—Have good light and examine the breast from various angles, bearing the following points in mind: Difference in size, color of skin especially over the growth or affected area, presence of sinus or ulceration, presence of enlarged or prominent veins and their radiation; presence of “dimpling”; appearance of nipple and areola; and enlargement of breast from inflammatory or tumor mass. Discharge from nipple. Examine both breasts.

Palpation.—Should be carried out with the flat of the hand and the tips of the fingers. The flat distal two-thirds of the index, middle and ring fingers will be found most useful. With the aid of the flat surfaces of these fingers very gently palpate the entire gland and observe whether or not it corresponds in all respects to the breast on the opposite side. A somewhat deeper palpation should follow. By this means, the contour, location, size, consistency, singleness or multiplicity of the lesion, presence of tenderness and the mobility or fixity of the affection may be determined. The consistency of the nipple should, too, be noted. The weight of the breast especially with the patient in a sitting posture may be determined.

Very gentle and extremely superficial palpation may elicit signs of *slight skin adherence* though sites of very superficial adherence may more readily be determined by gently grasping the breast at its base with both hands, and lifting it forward. Examine axillary and cervical glands for enlargement or tenderness and note, if present, hand or arm edema. At times a blood examination or the examination of the discharge from the nipple may be helpful. Occasionally a Wassermann test is indicated.

INTERPRETATION OF HISTORY

Age.—*Birth and Infancy.*—Amastia (absence of mammary gland), double nipple, supernumerary breasts, caked breasts and syphilis.

To Puberty.—Precocious development, mastodynia.

Puberty.—Mastodynia, inflammation, tuberculosis, and actinomycosis.

During Menstruation.—Swelling and tenderness, acute mastitis, mastodynia.

During Pregnancy and Lactation.—Fissures of nipples, excoriations, acute mastitis, caked breasts (non-pyogenic), galactocele, hypertrophy.

Puerperium.—Congestion and engorgement, "caked breast," acute mastitis, acute abscess, chronic abscess.

Young Women.—Tuberculosis, benign tumors, sarcoma.

Adult Life.—Tuberculosis, carcinoma, sarcoma, benign tumors, actinomycosis.

Fourth and Fifth Decades.—Carcinoma, tuberculosis, Paget's disease and sarcoma.

About Menopause.—Chronic mastitis, carcinoma, tuberculosis.

Fifty Years and Over.—Carcinoma, Paget's disease, perhaps benign tumors.

Sex.—All pathologic conditions of the breast are found very much more frequently in the female than in the male, though mastodynia in the youth at the time of puberty, and slight temporary enlargement of the breast at the same time are not infrequent. Tumors, both benign and malignant, as well as the infectious granulomata, are at times noted in the male.

Married or Single.—Malignant tumors of the breast are perhaps more frequent in the married than in the unmarried woman. The single benign tumor is more frequent in the unmarried woman.

Family History.—Hereditary history may have some bearing on a diagnosis.

Personal History and Present Illness.—*Complete marital and menstrual history* is of the utmost importance. Thus, a mastodynia is most apt to become more acute, and perhaps only exhibit itself at the time of menstruation; benign tumors of the breast become larger and very often more painful during menstruation; there are often acute exacerbations of a chronic mastitis during menstruation; and an acute mastitis is more prone to become more severe during the same period. Malignant tumors may, however, show signs of both enlargement and pain during the menstrual period, though this is rarely, if ever, as pronounced as is the case with the benign tumors. Often an enlargement of the thyroid gland accompanies the enlargement of the breast during the menstrual period. Chronic mastitis usually occurs in those who have borne children but who have not nursed them. The acute inflammatory conditions naturally occur more frequently in those who are married and who have, or are about to bear, children. Women who have had trouble with their breasts during lacta-

tion are perhaps a little more prone toward carcinoma than are others; this last statement is disputed by many. In our experience that factor does not occupy an important rôle.

<i>Onset</i>	{	rapid	{ acute puerperal mastitis hypertrophy of pregnancy abscess galactocele sarcoma malignant tumor of pregnancy (especially carcinoma). Malignant tumors of the breast occurring during the pregnant period are generally very malignant and rapid in course
		gradual	{ chronic mastitis tuberculosis, though this is stimulated by pregnancy gumma chronic abscess carcinoma benign tumors actinomycosis
<i>Chills or Fever or Both</i>	{	acute mastitis abscess during pregnancy secondary pyogenic inflammation of tumors, tuberculosis and actinomycosis	

Cough and Dyspnea.—Present when mediastinum is invaded, when large vessels are encroached upon, and when there is metastasis to the trachea, larynx, bronchi and the lungs. Toxemia may cause these symptoms.

Previous Treatment.—Pastes, massage and electricity are so frequently used as therapeutic measures, and wrongly, that it is of the utmost importance that we go into that phase of the history completely. Our prognosis will always be more conservative and more unfavorable regarding malignant tumors if the above treatments have been resorted to. The opening up of the lymph-channels and giving opportunity for tumor cell spreading are always increased by the above.

Pain: Character and Radiation.—This symptom is to a great extent dependent upon the amount of inflammation present, and to the amount of pressure upon the surrounding nerves and nerve trunks. The deeper seated the process, the more likely is the pain to be severe. Pain is therefore a usual symptom of acute mastitis, and of tumor masses, benign or malignant, if the process presses or encroaches upon nerve tissue, or has invaded or extended to the latter. Pain means but little in breast conditions. Pain radiation has but little significance unless the process has so far advanced as to involve adjoining or distant nerves.

Injury.—A history of such is often given by patients; possibly malignant tumors follow injury; at any rate, evidence seems to prove that it is perhaps present in a certain number of malignant cases.

Is the Affection in Any Way Connected with Pregnancy?—This applies more especially to mastitis and caked breasts; malignant tumors accompanying pregnancies often assume a most rapid fatal termination.

Physical Examination.—*Contour and Consistency.*—**HYPERTROPHY.**—Regular and usually normal to the feel,

CAKED BREASTS.—Entire breast enlarged and engorged and may have a slightly irregular feel, due to breast lobules.

ACUTE MASTITIS.—May give an irregular feel with scattered areas of doughy consistency.

TUBERCULOSIS.—Usually irregular, lobules quite mobile.

ACTINOMYCOSIS.—Usually irregular, lobules quite mobile.

ABSCESS.—If not too deep, a sense of fluctuation in an otherwise normal feeling breast.

SYPHILIS (GUMMA).—Hard, regular, or elastic, regular mass.

GALACTOCELE.—Usually irregular with one large, fairly fluctuant area.

CARCINOMA.—Varies considerably; may feel a small, regular, movable mass or may detect an irregular and hard and quite immovable one. Varies greatly.

SARCOMA.—Usually presents as an irregular and rather hard mass. May be movable or fixed. Usually quite diffuse throughout breast.

BENIGN TUMORS.—Usually regular in outline, quite freely movable and hard.

Location of Tumors.—Anywhere.

Size of tumors depends upon progress of disease.

Single or Multiple Tumors

<i>Single</i>	<i>Multiple</i>
Benign tumors (as a rule)	Actinomycosis (as a rule)
Carcinoma (as a rule)	Tuberculosis
Sarcoma (as a rule)	Chronic mastitis
Abscess	Diffuse fibromata
Syphilis	

Movable or Fixed Tumors.—Depend upon the progress of the condition; that is, upon the extent of the lesion; on the presence of infiltration or extension to the surrounding tissues, and upon the extent of the peri-inflammation. *The most malignant type of carcinoma, for instance, is probably at first, a movable tumor.* Therefore, practically all the tumors, both benign and malignant, are movable and do not assume the fixed stage until fairly well advanced. Benign tumors almost invariably remain movable. *Do not, in any case consider that because a tumor is movable it is not malignant; remember that a most malignant tumor may be movable until a very late stage.*

Masses (Discrete or Confluent).—**ACTINOMYCOSIS.**—Usually confluent.

CARCINOMA.—Discrete.

SARCOMA.—Discrete (later, confluent).

BENIGN TUMORS.—Discrete.

TUBERCULOSIS.—Usually confluent.

SYPHILIS.—Discrete (later, confluent).

CAKED BREASTS.—Usually scattered areas of discrete masses.

Appearance and Location of Sinus, if Any

Actinomycosis, in later stages; escape of yellow granules.

Tuberculosis, in later stages.

Malignant tumors, if broken down.

Any inflammatory process with infection and subsequent degeneration of the tissues.

Color and Consistency of Skin over Lesion.—The absence of a change of color or consistency of the skin means nothing, and it is therefore unwise to base any conclusions upon a negative symptom. When, however, a bluish discoloration occurs over the site of lesion or tumor mass; when there appears a, perhaps, very small or large amount of dimpling of the skin directly over the growth; when enlarged veins appear in the neighborhood of the palpable mass; when a blush seems to pervade over a part or the entire breast; when the skin becomes brawny or apparently infiltrated by new types or tissue; then we must consider that these symptoms have an important bearing on the case.

A blush or redness over the site of the breast lesion signifies one of two things: Either a beginning breaking down of the tissues in that neighborhood and a chemical reaction going on within the breast, or the presence of infection of some kind or other. It may signify, perhaps, an invasion of the tissue by tumor cells. A bluish discoloration over a tumor mass is, as a rule, significant of an invasion of the skin and a very early disintegration of the tumor, *per se*. The casual observer often overlooks this important sign.

Dimpling of the skin over a tumor mass is of the utmost importance as a clinical sign and should be looked for in all breast conditions. It should immediately signify to the observer an early invasion of the skin by tumor tissue, or, as is sometimes the case in inflammatory conditions, it is significant of a peri-inflammation. In the case of actinomycosis and tuberculosis it is usually a sign of invasion of the skin by the pathologic tissue itself.

Enlarged veins over the region of a breast tumor or other pathologic conditions of the breast signify a fairly rapid and extensive invasion or growth.

Pain on Manipulation.—As a rule, the only pathologic conditions of the breast which will elicit marked pain on manipulation are the inflammatory affections, including acute abscess and mastitis. But one should remember that extreme pain may be brought about by the manipulation of a breast with any condition in which the pathology has advanced.

Appearance and Palpation of Nipple.—In making a diagnosis of carcinoma of the breast it is imperative that the appearance of the nipple should not be considered too seriously. A well-marked carcinoma may exist with the normal appearing nipple. Retraction of the nipple does occur in a certain number of carcinomata of the breast but the retraction generally comes on after the process has become fairly well advanced. In Paget's disease the appearance of the nipple is, of course, the important issue, and has, to a certain extent, certain characteristic appearances. At first, there appear small gray scales on the nipple which resemble the pathology of eczema; there is a slight redness of the contiguous parts of this structure. The areola then becomes involved. Fissures are common. A bloody discharge should always be looked upon with suspicion.

Unilateral or Bilateral.—Hypertrophy and chronic mastitis are very often bilateral, though any of the malignant tumors may invade both breasts.

Axillary and Cervical Glands.—Axillary gland involvement often occurs in malignant tumors of the breast. This is also true in the inflammatory conditions. Actinomycosis and tuberculosis, at times, cause axillary enlargement.

Cervical gland involvement often occurs in the late stages of carcinoma, and at times in the late stages of sarcoma.

Presence of hand or arm edema is often due to pressure upon the large vessels.

This occurs in the late stages of malignant tumors.

Blood-Count.—Leukocytosis is present in the acute inflammatory conditions.

Inflammatory Conditions

Congestion.—This is a non-pyogenic affection of the breast, which is really an engorgement, caused by a distention of the galactophorus ducts with milk and with a corresponding dilation of the breast blood-vessels. It is most commonly found during the puerperium. Suppuration may take place, though, as a rule the condition clears up. The breast is uniformly enlarged and tender and at times is warmer than the one on the opposite side. Slight constitutional disturbances, such as a mild degree of breast pain and moderate temperature, may be present.

Acute superficial or subcutaneous inflammation is due to an infection by organisms of the lymphatics supplying the tissues just beneath the areola, or within its neighborhood. The infected area becomes red and swollen, tender to the touch and at times almost resembles an erysipelatous blush. The condition, as a rule, extends superficially and often definitely involves the skin in its advancement.

Acute deep or parenchymatous inflammation is essentially the condition termed “acute mastitis.” Its etiologic factors are abrasions on the nipple, areola or skin in some portion of the breast, which becomes secondarily infected. Acute infectious diseases occasionally bring about this condition. The breast is more or less uniformly affected, the infection extending along the interlobular septa, causing the breast to become honeycombed through degeneration. Areas of pus are scattered throughout the breast. The extensiveness of involvement is often so great as to cause the breast to become uniformly enlarged and tender with scattered areas of deep and superficial fluctuation, interposed between hard and indurated portions of mammary tissue. Constitutional symptoms such as headache, malaise and high rise of temperature, are often present and diffuse pain, more pronounced in some areas than in others, is an almost constant symptom. The glands in the axilla may become somewhat enlarged and tender, but this is by no means constant.

An abscess, when situated within the breast itself, is distinguished by its sensitiveness, fluctuation and at times its property of causing an asymmetrical enlargement of the gland proper. Multiple abscesses are more common than the solitary type and generally represent an advanced stage of acute mastitis.

Retromammary Abscess.—This is a condition in which there is present an accumulation of pus behind the mammary gland. It may be hematogenous in origin but is usually an extension from the breast itself. The breast often becomes “pushed forward” and pain, deep seated in character, may become pronounced. The glands in the axilla become enlarged and tender. Difficulty in moving the arm and true septic symptoms often present. It should be remembered that in this condition the skin over the anterior surface of the breast does not become reddened, and fluctuation is rarely detected. It is uncommon.

Chronic inflammatory conditions but represent long standing processes of acute lesions.

DIFFERENTIAL DIAGNOSIS OF INFLAMMATORY CONDITIONS OF BREAST

Symptom	Retromammary Abscess	Acute Mastitis	Acute Abscess	"Caked Breasts," Non-pyogenic
Age	Especially in young women.	Same.	Same.	Same.
Onset	Acute.	Acute.	Acute.	Fairly acute.
Relation to pregnancy	Often.	Often.	Often.	Yes.
Chills and fever	+	±	±	±
Pain (character and radiation)	Deep seated, very intense.	Usually not severe, occasionally painless. Possibly severe.	Fairly severe.	Slight, may be severe.
Size and contour	Breast may have a uniform elevation.	Usually regular.	Elevation over site.	Enlarged, somewhat nodular.
Single or multiple	Single.	Single or multiple.	Single or multiple.	Multiple.
Movable or fixed; consistency	Fixed. Perhaps hard and indurated.	Hard and indurated. Perhaps scattered fluctuation.	Same.	Fixed; boggy.
Color and consistency of skin over lesion	Depends upon its invasion—usually normal—occasionally indurated—reddened.	Red, brawny and indurated.	Same.	Venous engorgement. May be brawny.
Discrete or confluent	Discrete.	Confluent.	Discrete or confluent.	Confluent.
Pain on manipulation	++	+	+	±
Blood	Leukocytosis.	Leukocytosis.	Leukocytosis.	Usually normal.

Granulomata

Tuberculosis is a rare condition in this location, but it is not as uncommon as is generally supposed. It may be primary or secondary and is most frequently found in young women; as a rule slow in development, it may be hastened considerably by lactation or menstruation. The disease is generally unilateral. Axillary enlargement is often present which may be due to bacterial invasion or to what may be termed "a chemical cause" without any definite bacteriology. Two forms are recognized; namely, the discrete and the confluent. The *discrete* form of tuberculosis of the breast as a rule is a slow process of tuberculous invasion. There is not much enlargement of the gland and at an early period there is no adherence of the skin, though there are scattered areas of induration which, as a rule, are freely movable and quite hard. Some are distinctly separated from the surrounding tissue, while others have a tendency to merge into the gland proper. As the process advances, there appear scattered areas of skin adherence, overlying sites of semi or complete fluctuation; fistulæ are likely to form; generally there is little or no pain.

The *confluent* form represents a fairly rapid tuberculous invasion. Fistulæ form early. Throughout the breast there is a uniform mass, quite solid and showing areas of extreme hardness and scattered sites of an almost fluctuation. The breast becomes very irregular, the skin assumes a dark tawny color and numerous scattered sinuses appear. The superior external quadrant of the breast is the most common site for its beginning. The axillary glands may soften quite rapidly and there is a tendency toward abscess, both within the breast and regional glands. Occasionally there is retraction of the nipple. Slight evening temperature may be noted and often there is present a pulmonary tuberculosis. In this type the tubercle bacilli are often isolated.

Actinomycosis of the breast is extremely rare. It is characterized by a slow and at times very sluggish irregular enlargement of the gland, with formation of scattered areas of hardness, interspersed with zones of fluctuation. The skin, especially over the degenerating areas, becomes markedly adherent to the underlying tissue. Multiple sinuses, as a rule, appear, from which is discharged a pus containing yellow granules and the ray-fungus.

Blastomycosis presents practically the same picture as does actinomycosis with the exception that the pus has not the characteristic appearance as has the latter. The fungus of this lesion is found in the discharged pus.

Syphilis as an *initial* lesion is rare. When it does occur, the most common location is on the nipple of the nursing woman (especially at the junction of the nipple and the areola. The ulceration may be covered with a crust or it may be open, showing a small fissure with well-marked ulceration. The initial lesion may be multiple. There is axillary involvement.

Diffuse syphilitic infiltration is a condition in which a portion or the entire breast is enlarged, hard and sometimes very painful. It is usually part of the secondary stage.

A *gumma* may appear in any part of the breast; at first it is hard, circumscribed and usually slow growing, later on having a tendency toward breaking down and ulcerating through the skin which has become adherent and has assumed

a dirty dark and congested appearance. Pain may be entirely absent. Occasionally the process of growth may be rapid. Spirochetes are often found in the discharge.

Cysts

General Cystic Disease.—This condition is really a diffuse, chronic mastitis with cyst formation. The only difference is in the degree. It is often bilateral and especially appears in the young adult woman. It is usually unattended by pain, though during the menstrual period “soreness” is often complained of. The lesion is characterized by scattered, regular or somewhat irregular masses, freely movable and with no adherence to the skin or underlying tissue.

Retention cyst usually follows a previous breast disease or injury, but may develop without any previous history. Its size varies and it may be fairly slow or rapid in its formation. It is a regular, round or oval swelling, somewhat of an elastic consistency but may be of an almost stony hardness. Occasionally, it will fluctuate. The mass, as a rule, is quite freely movable; there is no pain or tenderness, and adherence of the overlying skin is unknown.

Lymphatic cysts are firm, hard masses, round or oval in size and usually multiple. As a rule, they are as large as a hazelnut, though their size varies. They are freely movable, unassociated with pain or tenderness and there is no adherence of the overlying skin.

Galactocele is essentially a “milk cyst.” It usually develops in the stage of lactation or after the child has been weaned. Trauma is supposed to be an etiologic factor. Its contents are essentially milk or some milk derivative. The mass is usually singular, and the swelling is generally situated in one of the external quadrants. It is usually fairly rapid in its development and, as a rule, there is some fluctuation on palpation. The mass is not freely movable and may or may not be tender. The contents, on pressure, may be expelled through the nipple. Ulceration is occasionally present; but “pitting” on pressure is not uncommon. A fluctuant tumor, developing suddenly in the breast of a nursing mother, is often the first symptom of this condition.

Sebaceous and dermoid cysts often form about the nipple. They are usually small, freely movable and regular but may give rise to a sharp pain in the breast. They occasionally appear in the breast of a diffuse hypertrophy. The dermoid cyst is extremely rare.

Echinococcus cyst of the breast is a rare condition and only appears in women. It may involve any part of the gland and begins as a small, circumscribed swelling, freely movable, and increasing slowly in size. The cyst may become rapidly adherent and show a rapid tendency toward ulceration. In the later stages of the disease, it becomes painful. Sinuses form and hooklets may be found in the pus. The axillary glands become involved.

Hypertrophy

This affection may be of congenital origin or, as is usually the case, an abnormal increase in the size of the breasts, either at puberty or during pregnancy. Its etiology has not been determined. A progressive enlargement of both breasts is

the rule, though the writer has but recently seen a case in which the hypertrophy was entirely limited to the one side. The patient usually calls the surgeon's attention to this condition both on account of the asymmetry which it causes and because of the weight and discomfort which so often causes a "sense of dragging" in the upper part of the back. Two stages of the affection are described by some authors. One, however, simply represents an exaggeration of the symptoms, and the two stages then merge into one another. The breasts are heavy and may attain great size. They are regular in contour, no masses are noted and the overlying skin is unaffected. As the hypertrophy increases, the superficial veins become dilated and there may be scattered areas of ulceration.

Tumors

BENIGN

Periductal fibroma of the breast is usually a hard and freely movable mass, not adherent to the skin or underlying tissue and with no tendency toward axillary involvement. It is usually single and, as a rule, occurs in young women.

Periductal myxoma corresponds in all respects to the periductal fibroma with the exception that some of the fibrous tissue has become transformed into myxomatous tissue.

Periductal sarcoma which, at times, assumes a state of malignancy, clinically corresponds in all respects with the other tumors of the fibrous type. Microscopically they may become sarcomatous, in which case clinical aspects of malignancy will appear.

Fibrocystadenoma and papillary cystadenoma exhibit the same clinical aspects as do the periductal fibromata with the exception that the papillary cystadenoma may grow to a considerable size and there may be a bloody discharge from the nipple, though in these tumors multiplicity is often present.

Simple adenoma of the breast is the rarest type of the fibro-epithelial tumors, and should not be confused with the adenomata so often referred to in the textbooks. This type of tumor is generally single, is soft, nodular, definitely localized and not adherent to the skin, but fixed to the gland itself. It is freely movable over the overlying muscles. It occurs in young adult to middle age.

Lipoma of the breast is a rare tumor. It may appear in one of three places; namely, in the gland itself, in the subcutaneous tissue or in the retromammary region. It is single or multiple, large or small and is stimulated in its growth by pregnancy. As a rule, however, it is slow in development, very movable and often pedunculated. It is not sensitive to pressure but is often painful.

Chondroma is of extreme rarity in this location. Its main interest lies in the possibility of becoming malignant, in which instance it will assume the characteristic of a mixed tumor.

Myxoma is rare and may be soft or hard in consistency. It is usually encapsulated and perhaps lobulated. It has a tendency toward becoming malignant, and axillary involvement then becomes common.

Angioma appears as a soft, elastic tumor, painless and not sensitive to pressure. It often pulsates and may become reduced in size on pressure. It is usually freely movable and there is no adherence to the skin. The breast itself may appear

on inspection to be "somewhat uneven." The cutaneous veins often show dilatation.

Endothelioma is so extremely rare in occurrence that it should be considered as only a vague possibility. They are very vascular tumors, with the formation of a tumor mass which is not encapsulated, but which is quite movable.

MALIGNANT

Carcinoma.—Carcinoma of the breast may be divided into various types pathologically, namely:

Adenocarcinoma	Gelatinous carcinoma
Medullary	Carcinoma cyst
Scirrhus	Squamous
Carcinoma simplex	Acute miliary carcinosis

From a clinical standpoint, however, it is practically impossible to differentiate so concisely. We should, therefore, be content in recognizing clinically:

1. Adeno or medullary carcinoma
2. Scirrhus or carcinoma simplex
3. Gelatinous or carcinomatous cyst
4. Squamous carcinoma
5. Acute miliary carcinosis

In *Group 1* we have a progressive, fairly rapidly growing tumor mass of an infiltrating type, rather soft in consistency, with a tendency toward invasion of skin with the formation of ulceration, and perhaps pedunculation. The tumor itself at first is fairly movable and can usually be distinguished from the remaining breast tissue. As the growth advances, however, definition between pathologic and normal tissue becomes impossible. In this type of carcinoma, pain is at times quite pronounced. The axillary lymph glands are fairly early invaded.

Group 2 presents, as a rule, as a rather hard, movable, painless, rather slow growing nodule within the breast, which, as the disease progresses, becomes larger and adherent to the skin and underlying tissue, causing a corresponding dimpling and perhaps later on a retraction of the nipple. The mass at first is quite regular in contour and later on becomes irregular and the line of definition disappears. In this type definite skin ulceration is less common than that found in *Group 1*, though in the scirrhous type a dense infiltration of the skin around the primary growth becomes so extensive as to involve the entire chest wall. We then have a condition of an "*en cuirasse*." The latter condition is quite rare, though this group as a whole probably represents the most common type of carcinoma of the breast.

Group 3, though of a clinical entity, occupies such a rare position from the standpoint of recognition and diagnosis that we should look upon it more from a true pathologic than clinical basis. The gelatinous type represents a mucoid change of the malignant tumor and may present as a nodular or diffuse type. The carcinomatous cyst nearly always presents *bloody contents*. The cysts themselves grow rapidly, but malignancy shows up clinically very slowly.

Group 4, the squamous-cell carcinoma, presents, as a rule, primarily as a chronic eczema of the nipple. The nipple at first appears thickened and reddened, surrounded, as a rule, by an inflammatory infiltration. Fissuring and thickening of the nipple usually precede the extension of a thickening which gradually reaches the galactophorous ducts. The nipple gradually becomes destroyed, and an extension into the breast takes place. The skin throughout the breast may show scattered areas of malignant cell infiltration, showing bright red, slightly raised ulcers with sharp edges. Cases of this kind are rare.

Group 5 presents a fairly rapidly progressing invasion of the skin, characterized by multiple small and large immobile carcinoma nodes. As the disease progresses, the deeper parts of the gland become involved and axillary metastasis presents.

Too much stress should not be placed upon the typical "textbook" picture of a carcinoma of the breast. Mistakes are so apt to occur, and the true existing condition from the diagnostic point can be so veiled that a symptom-complex of a breast tumor should not be considered too seriously. *We must remember that the atypical carcinoma of the breast is extremely frequent*, and we should consider the fact that the most benign small growth of the breast may be the beginning of a most vicious disease. *Dimpling* is of an extremely important diagnostic value in the early stages of carcinoma of the breast, and should be looked upon by the examiner as of marked diagnostic importance. The dimpling may be of varying degrees, depending upon the extent of the growth, and when present, and even though it be of the slightest degree, should be looked upon as of great importance. It should be remembered that the textbook picture, as a rule, is of an advanced case and very often beyond operative cure. Indeed, no typical symptom or sign may exist. True it is that carcinoma of the breast is found more in middle adult life and old age than it is in other periods. True it is that the female is very much more prone to the disease than the male. True it is that the most common type is around the menopause, but we must bear in mind that carcinoma may be and is found at any period of life, especially after the age of eighteen, and that the most malignant type of carcinoma of the breast that we can conceive of is that occurring in pregnancy or at the time of lactation. We should always be guided by the dictum that *every tumor of the breast should be looked upon with suspicion of malignancy and the earlier the disease is subjected to microscopic examination the more sure the cure.*

Sarcoma.—Comparatively rare. Solid and cystic forms clinically.

Rarely found after menopause and usually in young women. Round cell more malignant than the spindle cell; it grows more rapidly and is very fatal. Melanotic most fatal.

Contents of the cystic forms are often hemorrhagic, the hemorrhagic contents often exuding from the nipple. The cystic forms occur usually as large, succulent growths, imperfectly encapsulated and often somewhat movable. As cyst formation takes place it may become lobulated. Superficial veins become distended and the skin usually reddens and later may become ulcerated. The axillary lymph glands, as a rule, show no involvement until late in the disease.

The pure sarcomata are usually smaller, harder and more regular in shape. They are at first encapsulated and may later break through.

DIFFERENTIAL DIAGNOSIS OF CONDITIONS

Symptoms	Benign Tumor	Chronic Mastitis	Tuberculosis
Age	Especially in young women.	Especially during menopause.	Especially in young adult.
Onset	Very gradual.	Very gradual.	Gradual or fairly rapid.
Relation to menstruation	Often enlarges.	No.	May hasten progression.
Cough and dyspnea	No.	No.	Yes, if pulmonary or mediastinal involvement.
Pain (character and radiation)	No, or very light.	Same.	Slight or fairly severe. May not be present.
Size and contour	Regular.	Often bilateral, usually breast is smaller. Irregular.	Regular or irregular.
Single or multiple	Usually single.	Multiple.	Multiple.
Movable or fixed; consistency	Movable, hard.	Movable and nodular (hard or soft).	At first movable, then scattered adherencies. Fairly hard, then soft. Fixed, extreme hardness with scattered fluctuation.
Color and consistency of skin over lesion	Normal.	Normal.	At first normal, then blue, red skin and induration.
Sinus	No.	No.	Early or late.
Dimpling	No.	No.	Often.
Pain on manipulation	None, or very slight.	None, or very slight.	Usually slight.
Condition of nipple	Normal.	Normal.	May or may not be slight retraction.
Axillary or cervical gland involvement	No.	No.	Rapid involvement of axillary glands with necrosis.

Diseases of the Nipple

Paget's Disease.—This disease is a rare condition involving at first the nipple as an eczematous eruption of the nipple extending concentrically to the areola, which gradually becomes diseased, forming slight fissures with slight ulcerations, which may be either dry or moist, the latter condition being more common. It is a disease most commonly found in women between the ages of forty to sixty years, though, as a very rare condition, it may be found in the male.

Paget's description as quoted by Rodman is as follows: "It had the appearance of a florid, intensely red, raw surface, very finely granular, as if nearly the whole surface of the epidermis were removed; like the surface of a very diffuse acute eczema, or like that of an acute balanitis. From such a surface on the whole or

CAUSING BREAST TUMOR (CLINICALLY)

Carcinoma	Sarcoma	Symptoms
Usually after 40, but may be present at much earlier age.	Usually in fairly young women.	 Age
Usually gradual.	Fairly rapid.	 Onset
Usually none.	May hasten progression.	 Relation to menstruation
Same.	Same.	 Cough and dyspnea
No pain, slight dragging and gnawing or occasionally severe.	Slight or severe.	Pain (character and radiation)
Very variable: at first, small and regular, later large, possibly regular or irregular.	Enlargement of breast. Fairly regular—may be very irregular.	 Size and contour
Usually single.	Usually multiple.	 Single or multiple
At first freely movable and hard—later on fixed and hard.	Fixed. Of a brawny hardness.	 Movable or fixed; consistency
At first normal. Later on bluish or slightly reddened. Brawny.	Usually deep brawny appearance, venous engorgement.	 Color and consistency of skin over lesion
Occasionally in very late stages.	Ulceration may come on early.	 Sinus
Always present to some degree if one accurately observes.	Very often.	 Dimpling
Usually slight. May be absent.	Slight or severe.	 Pain on manipulation
May or may not be retracted. Extreme retraction often in later stages.	In advanced state often retracted.	 Condition of nipple
Occasionally not clinically involved. Usually involvement.	Usually not involved in early stages.	 Axillary or cervical gland involvement.

greater part of the nipple and areola, there was always copious, clear, yellowish, viscid exudation. The sensations were commonly tingling, itching and burning, but the malady was never attended by disturbances of the general health. In some of the cases the eruption has presented the character of an ordinary chronic eczema, with minute vesication, succeeded by soft, moist, yellowish scabs or scales, and constant viscid exudation. In some it has been like psoriasis, dry, with a few white scales, slowly desquamating, and in both these forms I have seen the eruption spreading far beyond the areola in widening circles, or, with scattered blotches of redness, covering nearly the whole breast."

Syphilis.—See "Syphilis of Breast."

AFFECTIONS OF THE HEART

Penetrating wounds of the heart and pericardium are relatively rare, and are mostly fatal. From lesser degrees of injury, tears of the pericardium or minor wounds of the heart will occur. Blood may escape with each contraction of the heart, or what frequently develops is an *hemopericardium*, or effusion of blood into the pericardial sac, the signs of which are similar to those of pericarditis with effusion. Cardiac wounds are attended by great shock. There are several cases on record in which foreign bodies have become embedded in the myocardium, causing precordial pain and, occasionally, variations in the cardiac rhythm.

Pericarditis with effusion occurs in two forms, the *serous* and the *purulent*. The chief occurrence of the former is on a "rheumatic" basis, while purulent pericarditis may be a sequel of the serous type, or it may arise secondarily to purulent foci elsewhere in the body or as a complication of a penetrating wound. The diagnosis is made by observing an increased area of cardiac dullness, usually of triangular shape; bulging or widening of the intercostal spaces; diminution or effacement of the cardiac apex; muffled or absent cardiac sounds; a rapid, feeble pulse; precordial pain or distress; dyspnea, and often cyanosis; and a constitutional reaction, the latter being more marked in the purulent form and accompanied by leukocytosis. A friction rub is occasionally heard. Of surgical interest is the occasional indication for aspiration of the pericardial sac in both forms of the affection.

Mitral stenosis is mentioned from the surgical standpoint only in relation to recent operations which have been performed for the purpose of enlarging the mitral ring or relieving the stricture by means of cardiotomy.

Dextracardia is a fairly rare phenomenon which may be either congenital or acquired. Congenital dextracardia is commonly found in conjunction with transposition of other viscera, but may exist alone. Acquired dextracardia occurs principally in association with pulmonary tuberculosis and mediastinopericarditis.

AFFECTIONS OF THE LUNGS AND PLEURÆ

Injury (see "Thoracic Injury")	{ penetrating non-penetrating
Foreign bodies	
Inflammatory conditions	{ abscess empyema (see "Pneumothorax") bronchiectasis gangrene pneumonia anthrax hemorrhagic pleurisy pleurisy with effusion acute fibrinous pleurisy
Granulomata	{ tuberculosis syphilis actinomycosis blastomycosis glanders

Pleural cavity affections	{ hydrothorax pneumothorax hemothorax pyothorax or empyema chylothorax
Infarct	{ thrombosis embolism
Parasitic cyst (echinococcus)	
Tumors	{ benign { angioma myxoma chondroma osteoma dermoid cyst fibroma lipoma } malignant { carcinoma sarcoma endothelioma } }
Nocardiosis	
Aspergillosis	

History

Age; Sex; Occupation

Family History.—Tuberculosis, syphilis, cancer and other tumors, heart and blood diseases, sudden deaths.

Personal History.—Tuberculous, complete venereal, alcoholic and marital histories; previous operations; heart trouble and any “blood disease”; enlarged glands, “back trouble,” acute infectious diseases and any other disease. Injury: type and date. Spitting of blood, cough, hoarseness, difficulty in swallowing, rapid breathing, and under what circumstances. Pain: type and radiation. Present inflammatory condition of neck, lungs or thoracic wall. Loss of weight. “Breath-holding,” if in infant or child. Expectoration and appearance of sputum.

Present Illness.—Accurate description of course of disease, including exact dates, if possible, and relation to present condition, including injury, pain, type and radiation, dysphagia, dyspnea, orthopnea, cough, hoarseness and loss of weight since the initial symptom.

Physical Examination.—Temperature, pulse, respirations. General appearance of patient, as regards adiposity and musculature, facial expression and signs of possible shock, decubitus, color of mucous membrane, pupils, equality and reaction to light and accommodation. Type of breathing and excursions of nasal alæ. Enlargement of cervical, supra- or infra-clavicular, axillary and inguinal lymph glands. Visible enlargement of thyroid gland.

Thorax Inspection.—Shape and symmetry, supra- and infra-clavicular grooves, position of apex beat. Thoracic wall “bulging,” dilatation of thoracic wall veins and edema of chest wall. Signs of injury, *i.e.*, discoloration or wounds. Presence of sinus and type of discharge therefrom. Pulsation: is it of the expansile type? Inflammatory signs.

Palpation.—Variations in tactile fremitus, palpable friction fremitus, subcutaneous emphysema, bony crepitus, pulsation, position of apex beat, expansion, thrill, palpable deformity, and paravertebral dulness, tenderness on pressure. Splenic enlargement, lymph glands, both regional and otherwise. Palpation of spine. Blood-pressure readings of both upper extremities.

Percussion.—Increased area of retrosternal and paravertebral dulness and other sites of abnormal dulness. Cracked pot sound. Flatness or tympany, diminished or impaired resonance, hyperresonance, coin sound, skodaic resonance.

Auscultation.—Determine quantity, rate and rhythm of cardiac sounds, presence and transmission of murmurs, presence or absence of normal breath sounds or an increase or decrease in their intensity; râles, pleuritic sounds, and friction rub, vocal fremitus (whispered and spoken voice), bruit, bronchial, cavernous and amphoric breathing, gurgling, metallic tinkling, succussion sound and cog-wheel breathing, tracheal tug.

Fluoroscopy and x-ray. Examination of sputum, blood (white-cell count and Wassermann). Reaction to antisyphilitic treatment. Examination of discharge from sinus, if any. Intelligent probing in case of presence of sinus. Aspiration.

INTERPRETATION OF HISTORY

Age.—*In Infancy and Early Childhood.*—Enlarged thymus plays an important rôle.

Young Adults.—Hodgkin's disease.

Adults.—Acute mediastinitis and abscess, syphilis, actinomycosis, retrosternal goiter, malignant tumors.

Middle and Old Age.—Aneurysm, and malignant tumors.

Sex.—*Males.*—Especially actinomycosis, Hodgkin's disease, syphilis and aneurysm. Too much significance should not be placed upon "sex."

Occupation.—The farmer and grain handler are most especially exposed to actinomycosis while the laborer exhibits often injuries (and their complications) of the lungs and pleura. Skin handlers and woolsorters exhibit anthrax, and cattle handlers and the like present glanders.

Family History.—Tuberculosis, syphilis, cancer and other tumors, must be considered; "blood disease" may refer to Hodgkin's disease; "heart-failure" and sudden deaths should include aneurysm and enlarged thymus.

Personal history of tuberculosis may lead up to a diagnosis of tuberculosis of the lungs and mediastinum while syphilis may be the etiologic factor of syphilis of lungs, pleura and mediastinum and aneurysm; cancer and other tumors—preëxisting breast conditions or carcinoma or other tumors elsewhere in the body (malignant tumor of the lungs or pleuræ, or mediastinum); possibly Hodgkin's disease, interpreted by the patient as a "tumor."

Heart Trouble and "Blood Diseases."—Aneurysm, Hodgkin's disease.

Acute Infectious Diseases.—The inflammatory condition of lungs, pleuræ and mediastinum.

Enlarged Glands.—Hodgkin's disease; perhaps malignant tumor.

Back Trouble.—Aneurysm; malignant or inflammatory condition of posterior mediastinum.

Injury.—Traumatic affection of lungs or mediastinum; aneurysm; infarct of lung.
"Spitting of Blood."—Lung injuries, pneumonia, atelectasis, pulmonary tuberculosis, lung abscess, tuberculosis of mediastinum with lung involvement, mediastinal abscess with extension to lung or bronchus. Malignancy with extension to lung or bronchus.

Cough.—This symptom may be present in any of the lesions.

Difficulty in Swallowing

Retrosternal goiter

Enlarged thymus

Acute suppurative mediastinitis

Malignant tumors with extension

Esophageal affections

Rapid Breathing.—May be a symptom of any of the pleural, lung or mediastinal affections.

Pain.—Tuberculosis of the mediastinum, especially along the course of the intercostal nerves, often in osteomyelitis of bony thorax. May be present in any of the inflammatory conditions or in the presence of any mass pressing upon nerve-centers.

Recent Inflammatory Condition of Neck.—Often the cause of any of the inflammatory conditions of mediastinum, lungs and pleuræ.

Loss of Weight.—Especially referring to tuberculosis, malignant tumors, the acute inflammatory conditions, with or without abscess, and to an advanced Hodgkin's disease.

Breath-Holding.—If in an infant, it is often present in an enlarged thymus.

Expectoration and Appearance.—Refers especially to tuberculosis, actinomycosis and lung abscess, when it is usually markedly increased, and with its definite and unique characteristics.

Physical Examination.—*Temperature.*—The afternoon rise in tuberculosis, the septic type in the inflammatory conditions.

Pulse.—Rapidity in the inflammatory conditions and the inequality of radial pulse in aortic aneurysm.

Respirations.—May be very rapid in any of the conditions, especially so in the retrosternal goiter, enlarged thymus, extensive malignancy and Hodgkin's disease, the inflammatory condition and aneurysm.

Enlargement of Lymph Glands.—Most especially in Hodgkin's disease and the malignant tumors, though inflammatory conditions may be accountable for their enlargement.

Visible Enlargement of Thyroid Gland.—May extend downward into the retrosternal region.

Thoracic Wall Bulging.—May be laterally present in a pleural exudate or lung tumor or there may be a prominence of the upper sternum and ribs in aortic aneurysm, mediastinal growth of abscess. Gumma of mediastinum may present this sign.

Dilatation of Thoracic Wall Veins.—Due to pressure on azygos veins.

Presence of Sinus.—Refers especially to tuberculosis, actinomycosis, the chronic lung and mediastinal conditions, malignancy with ulceration and to a necrosis of bony thorax with or without deep extension.

- Pulsation.*—The expansile visible pulsation of aortic aneurysm and the pulsation of acute mediastinitis, abscess or malignant mediastinal growth.
- Splenic and Liver Enlargements.*—Often show themselves in Hodgkin's disease and chronic mediastinitis.
- Palpation of Spine.*—At times Pott's disease is a cause of tuberculosis of the mediastinum.
- Blood-Pressure Readings.*—At times in aortic aneurysm and mediastinal growths and abscess formation.
- Radiography.*—Details of lungs, size and position of heart. Ribs and spinal column, including lower cervical spine. Great vessels. Position of diaphragm. With ingested barium in esophageal affections. With bismuth paste or lipiodol in the presence of a sinus. Anteroposterior and lateral views.
- Blood Examinations.*—Leukocytosis in pneumonia and abscess and other inflammatory conditions. Secondary anemia in malignancy, tuberculosis, syphilis, Hodgkin's disease, chronic lung and pleural affections, Wassermann reaction.
- Aspiration.*—Examination of aspirated material, in empyema, pleural effusions, hydrothorax, and lung or pleural tumor.
- Esophagoscopy.*—With or without passage of bougies. Indicated in various esophageal affections.
- Bronchoscopy.*—Diagnostic and therapeutic values. For foreign bodies, lung abscess, pulmonary tumors, combined with x-ray.
- Cytology and Bacteriology.*—Of sputum, exudates from sinuses and aspirated material.

Foreign Bodies

As indicated in the etiology of lung abscess, foreign bodies may gain access to the lung either from within or without, as the result of accidental injuries or violence. Children are especially apt to aspirate objects such as coins, peanuts, kernels of popcorn and small bones, while gunshot wounds constitute the most common source of foreign bodies introduced into the lung from without. In either event, excepting the signs of hemorrhage and lung injury in the case of penetrating wounds, foreign bodies result in two ways. First, the foreign body may excite no symptoms, merely producing a foreign body reaction and encapsulation; or, as more frequently occurs, infection supervenes, leading to bronchiectasis or abscess. Depending upon the site of lodgment, as when a bronchus is obstructed, partial collapse of the lung and atelectasis may occur. The history will usually suggest the presence of a foreign body; and bronchoscopy is of great value in diagnosis and localization—oftentimes in therapeutics, as well—particularly when the foreign body is not opaque to the Roentgen rays.

Inflammatory Conditions

Pulmonary abscess occurs in the presence of foreign bodies and penetrating wounds; in advanced stages of bronchiectasis; and following aspiration of infected mucus or pus from the upper air passages or mouth. It is particularly prone to follow tonsil operations, performed under general anesthesia, and such procedures as curettement or resection of the jaw, evacuation of retropharyngeal and peritonsillar abscesses and infections of the floor of the mouth. Also, a mediastinal abscess may

invade the lung secondarily. Foreign bodies gain access to the lung by inhalation, by penetrating wounds, such as bullet or shell fragment, or through surgical accidents such as the breaking off and retention of a portion of an empyema drainage tube. Also, tuberculous cavities may become secondarily infected with the production of a lung abscess. An abscess may also exist in association with empyema or following an infected thrombus or embolus. Obviously the preceding history is of considerable significance in diagnosis. The symptoms, such as cough, pain and expectoration, are frequently indefinite, while the physical signs are variable because of the possibility of partial or complete evacuation of an abscess through the bronchus and because of the situation of the abscess within the lung. This variability, however, if observed at different times, ranging from signs of consolidated lung to those of cavitation, bears great value in diagnosis. The sputum, too, may be characteristic—bulky, containing pus cells, elastic fibers and hematin crystals, and having a nauseating odor. Elevation of temperature and pulse and leukocytosis are present. Radiographs taken in the lateral, upright and horizontal positions usually demonstrate a lung abscess clearly, although there may be some difficulty in eliminating a primary malignant tumor. Postural change, with the head and thorax dependent, as over the side of a bed, will often produce free expectoration or increase the amount of sputum ordinarily brought up by the patient.

Empyema, in which the pleural cavity contains purulent fluid, is one of the most important surgical affections of the lungs and pleuræ. It is most often encountered after pneumonia and may occur at all ages from infancy onward. Other sources of empyema include penetrating wounds, foreign bodies, mediastinal abscess, subphrenic abscess, peritonitis, especially about the diaphragm, and the acute infectious diseases. The general symptoms are those of a septic infection; namely, elevation of temperature, sweating, progressive weakness, and often, chills. The pulmonary symptoms include dyspnea, cough, perhaps slight cyanosis, and sometimes pain. The physical signs are those of intrapleural fluid. In the examination of the chest, it is well to remember that bronchial breathing and even bronchophony may be heard over an empyema, but the *tactile fremitus is diminished*. This is particularly true in infants and children, in whom, however, pressure effects such as downward displacement of the liver and lateral displacement of the heart are more readily determined than in adults. Difficulty in diagnosis may be experienced in the empyema which follows pneumonia. A fever-free interval, after the pneumonic crisis or lysis, with subsequent swinging temperature, speaks strongly for empyema; while a moderate continuous elevation of temperature should bring to mind the possibilities of an unresolved pneumonia and thickened pleura. In doubtful cases, aspiration of the pleural cavity should always be attempted.

In extreme cases or in neglected patients, pulsations may be noted in the intercostal spaces or a bulging, pulsating mass is observed upon inspection of the thoracic wall. This latter condition represents nature's effort to evacuate the pus, and is known as *empyema necessitatis*.

As aids to the clinical findings, the leukocyte count, the aspirating syringe and radiography should be utilized. It is well to recall that an empyema may not be massive but may be interlobular in location, or sacculated, so that physical signs are then restricted to a small area, and aspiration is more difficult and frequently misleading.

Bronchiectasis arises upon chronic bronchitis as a basis, and is characterized by the physical signs of the latter condition, and paroxysmal attacks of coughing with profuse expectoration. Several ounces of sputum may be brought up at one time, especially in the morning. This sputum upon standing separates into a bottom stratum of pus and elastic fibers and a superimposed layer of clear mucus, and usually contains the typical *Dittrich's plugs*. The only surgical aspect of bronchiectasis is the occasional formation of a sacculaton or pouchlike diverticulum of a bronchus which gives the signs of lung abscess and which may call for surgical interference.

Gangrene of the lung represents an infectious necrosis of a portion of the lung with rapid cavitation, and may complicate abscess, bronchiectasis, infarction, echinococcus cyst and tuberculosis. The principal features are the copious sputum which separates into three layers upon standing and contains lung tissue; the loathsome, putrid odor of the patient's breath; and the progressive wasting and loss of strength. The signs are rather indefinite, or are those of cavity formation. Fever is usually present. The diagnosis is to be founded upon the preceding history, the putrid breath and the sputum examination.

Pneumonia is of interest to the surgeon from three standpoints. First, because it is the preceding condition of most empyemas, and it is incumbent before undertaking operation that the presence of an unresolved pneumonia, or delayed resolution should be eliminated and the diagnosis of *empyema* definitely established. In the second place, is the well-known occurrence of pneumonia with abdominal symptoms so that this disease must be sought for in every case of an apparently "acute abdomen." The third consideration is the comparatively frequent postoperative incidence of pneumonia. Both lobar and bronchopneumonic types occur, although thrombi from the site of operation produce a large proportion of the so-called postoperative pneumonias.

Anthrax sometimes produces a pneumonic process. It occurs in adults as a respiratory type of the disease. The onset is acute with pain in the chest, cough and chills. Rusty sputum is expectorated. There are signs of consolidation of large or small areas of the lung tissue with high temperature, rapid pulse and respirations. Occupation contributes materially to the clinical impression, the disease occurring in leather and hide handlers, but bacteriologic investigation is necessary for accurate diagnosis.

Pleurisy is of surgical importance in a differential diagnosis of chest pathology and because it frequently follows thoracic injury or complicates other surgical conditions. It may occur as a hemorrhagic type, with effusion or a fibrinous deposit. It occurs chiefly in adults and may follow blows, fractured ribs, acute infections, infarct of the lung from postoperative thrombus, exposure to cold or from an unexplained cause. The onset is acute with localized pain in the chest increased by deep inspiration or coughing. Dyspnea is often present with rise in temperature and acceleration of the pulse rate. Cough is a constant, troublesome complaint. With the fibrinous variety, a friction rub is heard on auscultation, often associated with limited dulness and suppression of the breath sounds. When effusion is present there is, from below upward, flatness, dulness, resonance, diminished or absent breath sounds or tubular breathing. Tactile fremitus is diminished or absent. Vocal fremitus may be diminished, normal or exaggerated. On the opposite side of the chest paravertebral dulness may be found. The cardiac apex beat may be obliterated or displaced, the liver forced

downward, the intercostal spaces made to bulge and respiratory mobility restricted. Radiographic examination will demonstrate the effusion or a fibrinous mat. Upon aspiration the fluid is clear, yellowish or amber, and odorless with the other characteristics of an exudate.

Granulomata

Tuberculosis may present surgical phases although, as a rule, the treatment is along medical and hygienic lines. Under certain conditions artificial collapse of the lung by means of surgical pneumothorax or multiple rib resections may be indicated, and infrequently a tuberculous pulmonary abscess may become of a surgical nature. Empyema of tuberculous origin also may demand surgical interference. Also the initial gastro-intestinal symptoms in some cases of pulmonary tuberculosis may lead to diagnostic errors. In addition, it is always of importance to verify or nullify the probability of pulmonary phthisis when frank or possible tuberculous processes are encountered elsewhere as in the lymph-nodes, bones and joints, spine, peritoneum, intestine and genito-urinary tract, and in fistulæ and abscesses about the rectum. Moreover, the selection of an anesthetic often depends upon the pulmonary findings. The surgeon then should be familiar, not only with the clinical manifestations and associations of pulmonary tuberculosis, but also with the physical signs in the various pathologic stages of the disease.

Syphilis of the lung is not common. It occurs in two forms, the *sclerotic* or fibroid syphilis, and the *gummatous* form. The symptoms resemble those of tuberculosis and may include hemoptysis in the gummatous type. Radiographs may be suggestive as also may the positive Wassermann test. Repeated failure to observe tubercle bacilli in the sputum should make one suspicious.

Actinomycosis of the lung in general gives the symptoms of tuberculosis. It should be suspected in long-standing cases in which the physical signs correspond to those of tuberculosis and yet the sputum is repeatedly negative for tubercle bacilli. Careful sputum examination will often reveal the characteristic ray-fungus. In late stages the pleura being involved, the chest wall is secondarily invaded and sinus formation takes place, usually affording a typical picture of actinomycosis.

The other mycoses of the lung are very similar clinically to actinomycosis, and are to be differentiated principally by sputum examination.

Blastomycosis.—The radiographic pictures in actinomycosis and blastomycosis may be quite distinctive although considerable care must be exercised in differentiating tuberculosis and multiple malignant tumors of the lung.

Glanders rarely involves the lung but may occur as a complication of the cutaneous manifestations. Adults are chiefly affected, especially those whose occupation is the handling of cattle, hides or leather. The onset is acute with symptoms similar to those found in anthrax of the lung, *i.e.*, pain in the chest, cough and chills, high fever, pulse and respiration rate. Consolidation of a small or large portion of the lung is found. A bacteriologic examination of the sputum is essential for an accurate diagnosis.

Pleural Cavity Affections

The pleural cavity under various conditions may contain air or fluids, the latter including exudates, transudates and rarely chyle. At times, both air and fluid are

present, producing for example, a pyopneumothorax, or hemopneumothorax. Regardless of the type of fluid, the physical signs are similar, although the subjective symptoms depend largely upon the source of the pleural complication. The usual physical signs are visible: Bulging or obliteration of the intercostal spaces with decreased expansion on the affected side, and perhaps displacement of the cardiac apex, all to be noted upon inspection; dulness or flatness upon percussion, verging gradually upward to pulmonary resonance, or flatness, dulness and resonance from below upward, according as fluid, atelectatic lung and normal lung are encountered, these signs sometimes being associated with *Grocco's paravertebral triangular area of dulness*; upon palpation, the displaced cardiac apex may be located (or the apex beat may not be obtained) and, if sufficient intrathoracic pressure exists, the free edge of the liver may be felt below the costal margin; also, the tactile fremitus over the area of fluid is also diminished or absent. The common auscultatory findings are absent, or diminished such as breath sounds and similar alterations in the vocal fremitus. Important variations from the above may be met with; for example, the breath sounds may be bronchovesicular or bronchial, and the spoken or whispered voice may be transmitted with increased intensity. Such departures are not at all uncommon, especially in infants and children with empyema, and it is of greatest importance to carefully test the tactile fremitus, as this is practically always diminished or absent.

Hydrothorax occurs with special frequency as a complication of heart and renal disease and is usually unilateral and on the right side. The fluid is a transudate of low specific gravity; yellow, or straw-colored and clear. In pleurisy with effusion the fluid has similar characteristics with the exception of the specific gravity.

Pneumothorax.—In pneumothorax, a tympanitic note is heard upon percussion of the chest excepting over the area of compressed lung. The resonance is so greatly increased in some cases that the examiner obtains the impression of a flat note, a very confusing occurrence. Pneumothorax, from the surgical standpoint, is a complication of ruptured lung, either from penetrating wounds or fractured ribs, and is commonly indicated by the presence of subcutaneous emphysema and the signs of hemothorax and pneumothorax. Pneumothorax may also complicate pulmonary tuberculosis or rise spontaneously without evident etiology.

Hemothorax.—A true hemothorax is found in penetrating injuries of the pleura and lung, in rupture of a thoracic aneurysm, and infrequently when erosion of a large vessel in the course of echinococcus disease and gangrene allows blood to enter the pleural cavity. Combined symptoms of pleural effusion and internal hemorrhage are present, accompanied by a degree of shock commensurate with the pathology of injury. The signs of hemothorax and pneumothorax are frequently obtained. If fluid is aspirated it is frankly sanguineous.

Pyothorax has already been considered as *empyema*. The material obtained by aspiration is thick, yellowish or greenish-yellow pus, having a foul odor in some cases, especially when the origin has been from below the diaphragm. In early pyothorax, such as may be met with soon after pneumonia, thoracentesis will reveal a fluid like that found in hydrothorax, but cloudy and containing pus cells after centrifuging. The various types of intrapleural fluids may become secondarily infected with the production of pyothorax.

Chylothorax results from rupture of the thoracic duct and escape of chyle into the pleura cavity. The condition might be suspected when following a severe injury

such as a bullet or stab wound or fracture of the dorsal spine; signs of fluid within the chest appear gradually and increase daily and there is a rapidly progressive loss of weight and strength. Upon aspiration, characteristic white, sticky, fluid containing fat corpuscles and leukocytes is obtained.

Infarct of the Lung

Infarct of the lung may be due to thrombosis or embolism and is found in pyemia and endocarditis, particularly in the chronic varieties of valvular disease. What more concerns the surgeon is the occurrence of pulmonary infarction postoperatively. In these cases, the source is the operative site, and the affection is found particularly after abdominal operations where large vessels have necessarily been ligated, as in the female pelvis. For this reason, *pulmonary embolism* accounts for many sudden deaths after hysterectomy or other intra-abdominal operations. In other cases, gangrene of the infarcted wedge of lung may result, although this is infrequent. Infective thrombi may lead to abscess formation. However, in the majority of instances, infarction gives rise to signs of consolidation of the lung or to those of acute and fibrinous pleurisy, these conditions being explained by the usual peripheral location of the infarct. The attractive symptom is a sudden, sharp pain in the chest, this being followed by cough and expectoration, rise of temperature and pulse. Multiple thrombi or emboli account for lobar consolidation. Probably infarction is responsible for the bulk of cases which are ordinarily styled "postoperative pneumonia."

Parasitic Cyst

Echinococcus cyst of the lung is a rarity in this country. Its presence may be suggested when pulmonary symptoms arise in the course of an echinococcus disease of another organ, such as the liver. It should be recalled as a possibility in natives of countries where this affection is endemic. Echinococcus cysts are subject to infection, so that a pulmonary abscess may be simulated. Hooklets should be sought for in the sputum, and in material aspirated from the lung, providing the cyst is near the periphery of the lung and accessible to the aspirating needle. In the absence of infection, the glairy, mucoid substances withdrawn differ greatly from the contents of a pulmonary abscess. At times, radiographs may demonstrate daughter cysts within the parent cyst. The symptoms are similar to those of pulmonary tuberculosis or chronic pleurisy and the common physical findings are those of pleurisy with effusion. Possible complications are bronchiectasis, abscess and gangrene of the lung; perforation of the chest wall may follow hydatid disease of the pleura.

Tumors

Tumors of the lung may occur as *benign* or *malignant* growths. The former are very rare but angioma, myxoma, chondroma, osteoma, dermoids, fibroma and lipoma have been reported; they are seldom of a size sufficient to give clinical symptoms. The malignant tumors may be either primary or secondary. The primary forms are very rare, occurring as carcinoma, sarcoma or endothelioma. *Carcinoma*, primary or, more frequently, secondary, gives rise to the same signs and symptoms. The original growth

DIFFERENTIAL CHART OF THE SURGICAL AFFECTIONS OF THE LUNGS AND PLEURÆ

Symptom	Pleurisy with Effusion	Hemothorax	Pneumonia	Empyema	Abscess	Infarct	Benign Tumors	Malignant Tumors
Age	Mostly adults. Any.	Adults, chiefly.	Any.	Any.	Any.	Mostly adults.	Adults.	Any. Mostly adults.
Onset	Acute or gradual.	Acute, usually.	Acute.	Acute.	Rapid, gradual.	Sudden.	Chronic.	Fairly rapid.
Symptoms ..	Chest pain, dyspnea, increased pulse, usually fever, cough.	Chest pain, dyspnea, increased pulse, usually fever cough. Also signs of internal hemorrhage and of associated conditions.	Pain, rigor, cough, chill, rusty sputum, etc.	Chest pain, dyspnea, increased pulse, usually fever, cough.	Coughing attacks, profuse sputum induced by posture. Suggestion of tuberculosis or empyema.	Frequent-ly fatal. Sharp pain, cough, expectoration. May be few or no symptoms. Mediastinal pressure of associated symptoms, enlarged inlets.	Sense of oppression, deep pain, dyspnea, cough, expectoration. May be few or no symptoms. Mediastinal pressure of associated symptoms, enlarged inlets.	Vague or absent. Paroxysmal cough, fever, prostration, dyspnea upon exertion, deep chest pain, radiating to arm, hemoptysis, or symptoms of associated bronchiectasis, abscess or mediastinal invasion.
Physical signs	From below upward; flatness, dulness, resonance, diminished or absent breath sounds, or tubular breathing. Diminished or absent tactile fremitus. Normal diminished or ex-	From below upward; flatness, dulness, resonance, diminished or absent breath sounds, or tubular breathing. Diminished or absent tactile fremitus. Normal diminished or exag-	Consolidation of small or large areas of lobe of lung. High temperature, with rare rapid pulse and	From below upward; flatness, dulness, resonance, diminished or absent breath sounds, or tubular breathing. Diminished or absent tactile fremitus. Vocal fremitus. Paraverte-	Variability is significant; signs of consolidation or cavity formation. Fever, rapid pulse.	Those of pneumonia or acute fibrinous pleurisy.	Atelectasis, bronchiectasis, consolidation or signs of fluid.	Those of consolidation or fluid; of bronchiectasis, abscess, or mediastinal growth. In pleura, same as pleurisy with effusion

Physical signs (<i>cont.</i>)	X-ray and laboratory	aggregated vocal fremitus. Paravertebral dullness on opposite side. Succession sound. Perhaps displacement or obliteration of cardiac apex; downward displacement of liver; bulging intercostal spaces; restricted respiratory mobility.	respirations.	bral dullness on opposite side. Succession sound. Perhaps displacement or obliteration of cardiac apex; downward displacement of liver; bulging intercostal spaces; respiratory mobility. Evidences of septic condition. May be encysted.	X-ray.	X-ray.	X-ray.	or chronic fibroid pleurisy.
	X-ray typical. Guinea-pig inoculation. (Often tuberculous.)	X-ray typical. Guinea-pig inoculation.	Leukocytosis. Sputum. X-ray.	X-ray. Leukocytosis.	X-ray important. Sputum often purulent, copious. Leukocytosis.	Negative sputum.	X-ray. Repeated negative sputum.	X-ray of great value. Negative tuberculin. Aspirated pleural fluid, bloody, may contain tumor cells.
Additional data	Aspirated fluid clear, yellowish or amber, odorless.	Penetrating or non-penetrating injury, malignancy, aneurysm, aspirated fluid, bloody.	An important surgical complication of injuries, operations.	Usually follows pneumonia. Also acute infectious diseases, lung abscess, subphrenic abscess, tuberculousis; and may complicate other types of pleura effusions. Aspiration; cloudy or purulent fluid; with or without odor.	Pharyngeal and oral operations, foreign bodies, penetrating wounds and preceding lung disease important factors in diagnosis.	Complicates endocarditis, septicemia, surgical operations. May terminate in suppuration or gangrene.	Rare. When large, compress mediastinal contents and distort them. Rare.	Bronchoscopy very important. Carcinoma, sarcoma, endothelioma occur both as primary and secondary tumors. Loss of weight and strength may be delayed. Often infection.

Symptom	Foreign Body	Ulcerations (Including Tuberculosis, Syphilis and Malignancy)	Lungs (Wounds or Rupture)
Age	Any.	Any. Especially young adults and adults.	Any. Especially adults.
History	Aspiration of foreign bodies. Often none in infants. Rapid onset.	Aspiration of foreign bodies. Irritant gas or fluid. Pulmonary tuberculosis, syphilis, malignant tumors. Usually moderately rapid or gradual onset.	Acute injury. Rapid onset.
Subjective symptoms and signs	Paroxysmal cough, dyspnea, cyanosis. Recurrent pulmonary symptoms. If abscess is present, rise of temperature, signs of sepsis. Pain may or may not be present.	Pain, cough, dyspnea—progress of the disease responsible for bleeding.	Pain, dyspnea, cyanosis, cough, shock or general symptoms of internal hemorrhage.
Objective signs	Often absent. In lungs, may be those of atelectasis, consolidation or abscess. Radiography, laryngoscopy or bronchoscopy confirms diagnosis.	Usually negative except by laryngoscopic and bronchoscopic examination. May be signs of pulmonary tuberculosis, syphilis or new growths. Sputum may show presence of tubercle bacilli. Wassermann may be positive. Use of stethoscope.	Subcutaneous emphysema, pneumothorax or hemopneumothorax.

is found elsewhere in the body, the lung being involved by extension or metastasis. In an early case there is an afebrile cough with consolidation, but no râles. Later, pain in the chest is complained of, with dyspnea, bloody expectoration, signs of compression such as atelectasis or bronchial stenosis and increasing cachexia. The supraclavicular lymph-nodes may become involved. Examination of the sputum is negative but fluid aspirated from the chest is blood tinged and may reveal tumor cells upon microscopic examination. *Sarcoma*, as a rule, occurs at an earlier age than *carcinoma* but either may be found at any period of life. The condition appears as a lymphosarcoma which extends along the bronchial tree but which seldom invades the lung tissue proper. The condition is manifested by the same signs and symptoms as described under carcinoma, viz., cough without fever, and signs of consolidation without râles; pain in the chest, dyspnea, bloody expectoration and increasing cachexia.

OF HEMOPTYSIS

Thrombosis (Embolism)	New Growths of Lung or Mediastinum and Aneurysm	Pneumonia	Symptom
Adults.	Any. Especially adults.	Any.	 Age
Previous operation, especially laparotomy. Fractures, intravenous medication. Vascular wounds. Infections. Cardiac diseases. Rapid onset.	Onset is moderately rapid or gradual. May be syphilitic history or glandular enlargement or primary tumor elsewhere.	Acute, with rapid rise in temperature and, as a rule, initial chill.	 History
Sudden sharp chest pains, usually with temperature rise. Dyspnea, cyanosis; may be rapidly fatal.	1. Absent. 2. Mild pulmonary symptoms. 3. Those of tuberculosis or pleurisy. 4. Those of malignancy. May be dyspnea, cough, sense of compression. Perhaps dysphonia, dysphagia. Alterations of cardiac rhythm.	Rapid breathing, cyanosis, high temperature, often pain in chest.	 Subjective symptoms and signs
Localized pleurisy or consolidation (infarct). Pulmonary embphysema.	1. Absent. 2. Consolidation. 3. Atelectasis. 4. Massive pleurisy. 5. Pleurisy with effusion (bloody as a rule). Mediastinal growths or aneurysm show increased retrosternal or paravertebral dullness, with corresponding changes in signs over lungs. Radiography, determination of Wassermann reaction; blood-picture. Examination of aspirated fluid.	Pulmonary signs. Hyperleukocytosis.	 Objective signs

Aspiration reveals a bloody fluid which should always make one suspicious of malignancy. An *endothelioma* is found as a diffuse growth or as discrete nodules which give rise to an effusion tinged with blood. Symptoms arise insidiously and the condition may first be diagnosed as a pleurisy with effusion. The condition is most frequent in the pleura, the lung being involved secondarily. Pain is present as in a dry pleurisy. Aspiration of the bloody effusion with microscopic examination will aid in the diagnosis. A radiogram is valuable in all cases which are suspicious of chest tumors but a differential diagnosis as to the exact type of tumor cannot be formed by such means.

Nocardia and aspergillus are the two parasites (after actinomyces) found most frequently affecting the lung and pleura, but they occur very rarely. The parasites gain entrance through the oral cavity and develop wherever there is destruction of

lung tissue with stagnation and decomposition. The condition is not unusual in animals but is a curiosity in man. The symptoms are similar to those of tuberculosis and most cases are not differentiated until late in the disease, or at postmortem examination.

Etiologic Chart of Hemoptysis

Larynx	{	papilloma angioma carcinoma tuberculosis syphilis
Trachea	{	foreign body ulceration new growth
Bronchus	{	foreign body ulceration new growth
Lungs	{	penetrating wounds rupture foreign body pneumonia tuberculosis passive congestion mycoses syphilis parasites new growths thrombosis embolism caisson disease abscess gangrene
Pleura	{	endothelioma sarcoma carcinoma
Mediastinum	{	new growth Hodgkin's disease syphilis tuberculosis aneurysm esophageal diverticulum cardiac decompensation

AFFECTIONS OF THE MEDIASTINUM

Congenital {enlarged thymus

Inflammatory conditions {acute suppurative mediastinitis
abscess
chronic mediastinitis

Granulomata	{	tuberculosis syphilis actinomycosis
Retrosternal goiter		
Hodgkin's disease		
Aneurysm		
Thoracic duct injury		
Tumors	{	benign { lipoma fibroma chondroma dermoid cyst echinococcus cyst
		malignant { carcinoma sarcoma

Because of anatomic considerations, many of the affections of the mediastinum, particularly those of surgical interest, are manifested not by symptoms peculiar to various diseases, but rather by symptoms referable to disturbed function of the important viscera situated therein, or of adjacent structures secondarily encroached upon or invaded. Pathologic processes of sufficient size and extent to produce pressure symptoms are therefore strikingly similar in their clinical aspects, whether they be of inflammatory, new growth, granulomatous, lymphatic or other types. Pain, dyspnea, dysphagia, cough, hoarseness, dilatation of the veins of the thoracic wall, edema of the chest wall, interference with the cardiac action and loss of weight may be observed in numerous affections of the mediastinum. While regional physical examination may elicit distinctive or diagnostic signs in certain conditions, yet, for the most part, the final diagnosis of cases will depend greatly upon the recognition of significant features. These are derived from the history and general physical examinations, combined with the data obtained by laboratory investigation, especially radiography.

Enlargement of the Thymus Gland

Enlargement of the thymus gland, or persistent thymus, is a congenital affection manifested clinically by recurrent attacks of dyspnea and cyanosis, or by difficulty in swallowing, and infrequently by "breath-holding" upon the part of the infant or child. A persistent thymus quite commonly exists without producing any symptoms, particularly in children with the so-called lymphatic diathesis. It is the cause, however, of many sudden deaths in childhood, especially under anesthesia. The only physical signs are an enlarged area of retrosternal dulness and the corresponding absence of breath sounds. The radiographic findings are characteristic.

Inflammatory Conditions

Acute suppurative mediastinitis is practically always a secondary condition ensuing upon inflammatory processes of the neck and lungs, penetrating wounds, osteomyelitis of the bony thorax, perforations of the esophagus, trachea or bronchi,

gangrene of the lung, or rarely as a sequel of the acute infectious diseases. This affection usually leads to *mediastinal abscess* which may burrow for some distance, appearing externally between the ribs in the anterior or posterior chest wall, or in the supraclavicular fossa. The pressure symptoms of acute mediastinitis, exaggerated when a true abscess forms, are severe, deep-seated pain, dyspnea, cough, occasionally dysphagia, and frequently alterations in the cardiac rhythm. The profound constitutional evidence of concealed pus—chills, fever, rapid pulse, leukocytosis, and prostration—is of the greatest importance in diagnosis. Upon examination, there may be found tenderness upon pressure in one or more intercostal spaces or over the ribs or sternum; or objective signs may be entirely absent. With abscess formation, an abnormal retrosternal or paravertebral area of dullness is sometimes observed. Pulsation is occasionally seen in a mediastinal abscess which has reached the chest wall, requiring careful differentiation from aneurysm. The combination of distressing symptoms of mediastinal origin and the general appearance of sepsis constitutes the diagnostic basis.

Chronic mediastinitis is of an adhesive or tuberculous nature. Pressure symptoms are much less severe, while fever may or may not be present. A special form, Pick's disease, or adhesive *mediastinopericarditis*, is of interest because of associated hepatic enlargement and ascites. The preceding history of an acute mediastinitis, pericarditis or tuberculous involvement of ribs, vertebræ, sternum, or glands is of considerable value in diagnosis.

Granulomata

Tuberculosis of the mediastinum appears as a chronic mediastinitis, tuberculous lymphadenitis or as a tuberculous abscess. Lymph-node enlargements of tuberculosis are found particularly about the hilum of the lung, either independently or in association with pulmonary disease. They produce no symptoms if small, or only excite chronic cough unless of sufficient size to compress the bronchus. They are frequently demonstrable by radiography when calcification has taken place. A tuberculous abscess occurs in the posterior mediastinum as a sequel of tuberculosis of the dorsal vertebræ. The symptoms are of slow development, or may appear rather suddenly, with dyspnea, cyanosis, cough and fever. The temperature is sometimes elevated to 102° or even higher at night. Pain is usually present, and frequently radiates along the intercostal nerves. Patients become rapidly weak and exhausted, and generally lose weight rapidly. The condition should be suspected when any of the above mentioned symptoms arise in a patient with spinal tuberculosis. It is easily determined by radiographic examination.

Syphilis of the mediastinum appears pathologically as a *gumma*, although the mediastinal nodes may be moderately enlarged as part of the generalized lymphatic involvement. Gumma produces symptoms of mediastinal tumor or tuberculosis, from the clinical standpoint. Differentiation may be made by the history, objective evidence of syphilis elsewhere, the Wassermann reaction, and the response to antisyphilitic treatment.

Actinomycosis of the mediastinum arises as a complication of a similar affection of the lungs or chest wall, and is to be differentiated from tuberculosis only by the radiographic picture, or the clinical and microscopic findings in regard to external lesions, if such exist.

Retrosternal Goiter

Retrosternal goiter occurs as an enlargement of the thyroid gland, or in association with moderate or large goiters in the usual cervical location. Its presence is to be considered in all thyroid enlargements in which dyspnea and dysphagia are complained of, particularly when the subjective symptoms are out of proportion to the visible and palpable thyroid involvement. Occasionally a retrosternal goiter may be felt by the fingers when hooked over the upper extremity of the sternum; a more dependable finding is an increased area of retrosternal dullness upon percussion. Radiographic examination is of value.

Hodgkin's Disease

Hodgkin's disease may select the mediastinal lymph-nodes as the point of origin, although more frequently it arises in the anterior cervical region and progresses to the axilla and groins before attacking the mediastinum and retroperitoneum. The symptoms are those of mediastinal tumor. Important clinical findings under such circumstances are the youth and sex, bilateral lymph-node tumors in any of the accessible regions, sometimes splenic and hepatic enlargements and the palpation of retroperitoneal nodes, and the blood-picture—the latter because of its negative, rather than positive character. When the mediastinal affection is primary, patients are often suspected of having, or are treated for, pulmonary tuberculosis. The urgent symptoms and repeated negative sputum examinations should be highly significant, while the importance of early x-rays is obvious.

Aneurysm

Aneurysm of the aorta affects the ascending aorta, the arch or the descending aorta, with consequent modification of clinical symptoms and signs. As in other locations, aneurysm occurs principally in the male sex at middle age, and in those with syphilitic and alcoholic histories. The local symptoms are similar to those of tumor of the anterior or posterior mediastinum, and are often found in association with symptoms of cardiac or pulmonary origin. In aneurysm of the arch of the aorta, an increased area of retrosternal dullness is noted, usually with a blowing systolic murmur; tracheal tug, hoarseness, a "brassy" cough, and inequality of the radial pulses with corresponding discrepancy in the blood-pressure readings in the upper extremities. In advanced cases, an undue prominence of the upper sternum and ribs may be observed, and, at times, an expansile visible pulsation is seen in this locality. Aneurysm of the descending or thoracic aorta produces symptoms of mediastinal tumor, and occasions pain along the intercostal nerves, or, by erosion of the vertebrae, gives rise to deep-seated pain. In late stages, deformity of the ribs occurs, infrequently in conjunction with an appreciable pulsation. The more common findings are an area of paravertebral dullness, an audible systolic murmur, and elevated blood-pressure which may vary in the lower extremities. The Wassermann reaction and radiography, including fluoroscopic examination, are valuable diagnostic aids.

Symptom	Acute Mediastinitis and Abscess	Tuberculosis	Syphilis
Age	Any. Especially adults.	Any. Especially young adults.	Especially adults.
Onset	Rapid.	Gradual, as a rule.	Gradual.
Subjective symptoms and signs	Constitutional symptoms are profound, <i>i.e.</i> , high fever, chills, sweating and prostration. Pressure symptoms, <i>i.e.</i> , deep-seated pain, dyspnea and orthopnea.	There may be a slight rise in temperature, moderate rapidity in breathing and gradual loss of weight. Pressure symptoms are usually slight.	None, or pressure symptoms in varying degrees.
Objective signs	In acute mediastinitis, objective signs are frequently absent. In abscess, may have abnormal dullness, altered breath sounds or even pulsating chest wall mass.	Absent or are the same as in chronic mediastinitis or those of tumor. Signs of pulmonary tuberculosis are present.	Same as in chronic mediastinitis.
X-ray	Valuable when abscess is present.	Important.	Mediastinal shadow.
Special data	May be local etiologic factor. Leukocytosis.	Tubercle bacilli may be found in sputum. May appear as a chronic mediastinitis, hilum lymph-node enlargement and tuberculous abscess as a secondary process.	Wassermann reaction may be positive. Other signs of syphilis. Reaction to treatment.

Thoracic Duct Injury

The only important affection of the thoracic duct is injury and even this condition is rarely seen from a clinical aspect, because more vital structures are usually injured simultaneously by penetrating wounds leading to a fatal termination. The classical sign of thoracic duct injury is the *escape of whitish material (chyle) along the wound tract*. Occasionally, rupture of the duct occurs in conjunction with a fractured dorsal spine, and may be indicated by rapid loss of weight, or by the production of a chylothorax. The latter condition might be suggested by the rapid wasting and loss

DISEASES OF THE MEDIASTINUM

Actinomycosis	Hodgkin's Disease	Aneurysm	Malignant Tumors	Symptom
Especially adults.	Especially young adults.	Middle and old age.	Middle and old age.	 Age
Gradual, as a rule.	Gradual or fairly rapid.	Gradual.	Fairly rapid.	 Onset
None, or pressure symptoms in varying degrees.	Pressure symptoms are usually pronounced. Chills and fever often accompany dyspneic attacks.	Pressure symptoms which increase in severity.	Pressure symptoms. Loss of weight.	.. Subjective symptoms and signs
Same as in chronic mediastinitis.	Abnormal area of dullness (retrosternal or paravertebral), with change in breath sounds. Enlarged glands elsewhere. Liver and spleen may be enlarged.	Abnormal dullness; alterations in pulse and blood-pressure; tracheal tug. Cervical sympathetic changes, hoarseness, brassy cough, bruit.	Abnormal areas of dullness. May deform chest wall with overlying pulsation.	.. Objective signs
Mediastinal shadow.	Mediastinal shadow and signs of lymph gland enlargement.	Of diagnostic value.	Important.	 X-ray
Ray-fungus may be present in discharging lesions or sputum. May be chest wall sinus. Associated with pulmonary, vertebral or chest wall actinomycosis. Found, as a rule, in farmers and grain handlers.	Rarely primary in mediastinum. Bilateral glandular enlargements; progressive. Biopsy on excised tissue from an enlarged gland.	Occasionally chest wall prominence; pulsation or "pulsating tumor." Wassermann reaction may be positive.	Usually secondary to breast, thyroid, lung or thoracic wall tumors.	 Special data

of strength, but more often depends upon aspiration of the pleural cavity as the local signs do not vary from those of hydrothorax or hemothorax. Occasionally, the thoracic duct becomes involved in the course of a tuberculous or malignant process.

Tumors

Tumors occur especially in the form of *malignant* growths, usually secondary to primary affections in the bony thorax, lungs, pleuræ, breast, or thyroid gland. The pathologically *benign* tumors are rare, and, as a rule, are of small size, giving rise to

minor symptoms or attracting no attention. The symptoms are essentially those of pressure, and are referable to various anatomic structures. Tumors in the anterior mediastinum commonly produce substernal pain or sensation of pressure, while those in the posterior mediastinum often produce intercostal neuralgia or deep-seated pain in the back. A sense of suffocation with attacks of dyspnea and cyanosis is frequent. Pressure upon the vagus nerve gives rise to variations in the cardiac rhythm. Cough, dyspnea, and variable pulmonary signs are due to pressure upon a bronchus, while hoarseness is attributable to recurrent laryngeal nerve pressure. Distortion of the esophagus causes dysphagia, and involvement of the thoracic duct accounts for rapid loss of weight and strength. The diaphragm may be interfered with in its function, or even paralyzed by phrenic nerve pressure. Encroachment upon the aorta accounts for different blood-pressure findings in the upper or lower extremities, and pressure upon the azygos veins causes dilatation and tortuosity of the veins of the thoracic wall, and may produce edema because of the venous stasis. One or both lungs may be distorted, explaining various physical signs over the lungs. Occasionally, the cardiac apex is displaced, and careful physical examination will reveal that this is the result of pressure from without, rather than a sequel of cardiac hypertrophy or dilatation.

Bulging or deformity of the chest wall occurs when the tumor is of sufficient size; dulness or flatness may be elicited over the site of such deformity, or over the tumor, in certain instances, when no visible deformity exists. It is apparent that the symptomatology is diverse, while there is a paucity of significant physical signs. The pressure symptoms, however, are quite suggestive, and their interpretation and differentiation will usually lead to the proper diagnosis. As previously noted, inflammatory conditions including abscess, the granulomata, aneurysm, retrosternal goiter and enlarged thymus—in fact, any condition capable of encroachment upon or invasion of the compactly arranged mediastinal contents—will produce symptoms similar to those of new growth, and call for diagnostic elimination. The value of radiography has already been emphasized. Also to be remembered is the fact that various conditions, which are ordinarily pathologically benign or capable of being relieved or cured in other anatomic situations, are frequent causes of death when involving the mediastinal contents.

AFFECTIONS OF THE ESOPHAGUS

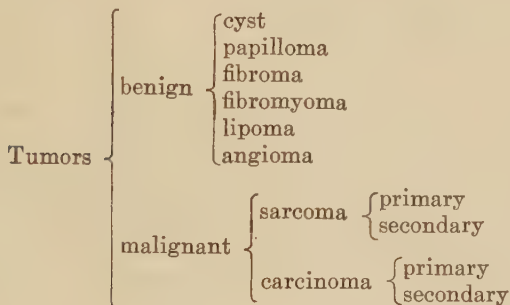
Injuries

Inflammatory conditions	{	acute catarrhal inflammation
	{	phlegmonous esophagitis
	{	chronic esophagitis

Foreign bodies

Ulcers	{	inflammatory	{	mechanical
			{	thermal
			{	bacteriologic
	{	granulomata	{	tuberculosis
		{	syphilis	
		secondary to malignant tumors		

Strictures
 Dilatation
 Diverticulum
 Rupture
 Perforation
 Spasm
 Varix
 Fissures



History

Age; Sex; Occupation

Family History.—Tuberculosis, syphilis and malignant disease.

Personal History.—Complete venereal, alcoholic and tobacco history. Acute infectious diseases and dates. Trauma and the history of the introduction of foreign bodies or of caustics into the mouth. Tuberculosis or malignant disease elsewhere in the body. Gastric disturbances including pain and the vomiting of blood. History of previous esophageal dilatation with sounds or bougies.

Present Illness.—Date of onset, character (acute or gradual). Any known cause. Are pain or difficulty in swallowing present and for how long? History of regurgitation of food, and time elapsing between the taking of food and its ejection from the mouth. Has neck tumor been noticed by patient and does it become larger upon the taking of food, or is it made smaller upon pressure? Vomiting of blood. Difficulty in breathing. "Choking sensation" upon the taking of food. Loss of weight and strength.

Physical Examination.—General inspection of patient including appearance of tumor mass in neck and its size in relation to the taking of food. Inspection of abdomen for distended veins. Palpation of cervical and supraclavicular lymph glands, entire thorax for physical signs and of tumor, if any (does tumor become smaller on pressure?). Palpation of epigastrium for signs of rigidity and tenderness. Of liver and abdomen for possible cirrhosis. Auscultation of entire thorax and esophageal region for abnormal pulmonary signs and deglutitory sounds. Examination with sounds, bougies, x-ray, esophagoscope; leukocytes, Wassermann reaction. Complete physical examination for purpose of determining possible etiology of the affection.

Injuries

Wounds of the esophagus are caused by trauma from without, such as incised, stab or gunshot wounds; and from within, brought about by the swallowing of sharp or rough objects, and by the introduction of instruments used for diagnostic or therapeutic purposes. The symptoms include bleeding, the escape of food through the wound, pain and oftentimes difficulty in swallowing, occasionally vomiting with the appearance of blood in the vomitus and usually extreme thirst. Secondary inflammatory symptoms soon appear, shown by neck induration and the accompanying signs of inflammation. Very often the trachea is involved, in which case food enters the air passages, causing choking, dyspnea and cyanosis and coughing—the result of which, pneumonia, is of common occurrence.

Inflammatory Conditions

Acute catarrhal inflammation may be due to mechanical, thermal, and chemical irritations as well as to infective processes of the mucous membrane. The symptom-complex of this condition depends entirely upon the severity and extent of the inflammatory process ranging from a slight hypersecretion of mucus and slight sensitiveness in the esophageal region on swallowing, to the most extreme dysphagia with a very marked increase in the amount of mucus. A persistent burning sensation throughout the thorax, pharyngeal and gastric regions may in severe cases be present. A complete stenosis of the esophagus may ensue, due to mucous membrane edema or to muscular contraction.

Phlegmonous esophagitis occasionally follows the acute inflammatory condition. In this type of inflammation, the constitutional symptoms are pronounced, including nausea and vomiting, severe pain, high fever, excessive cough and expectoration, dysphagia, with at times the vomiting of a large amount of pus. This condition is often due to an extension from without by a purulent focus.

Chronic Esophagitis.—The most common causes of chronic esophagitis are the constant use of alcohol, benign and malignant strictures, esophageal diverticula and dilatations, cirrhosis of the liver, diseases of the heart, and as the result of diphtheria and other acute infectious diseases. Ingestion over a long period of time of irritating substances may bring on the condition. The symptoms are those of the acute form, though milder in type.

Foreign Bodies

In the consideration of this subject, the size, consistency and contour of the foreign substance are important factors in determining the symptoms found. Smooth objects cause salivation, dysphagia, localized pain, involuntary efforts to swallow and retching and if of considerable size may lead to cyanosis, suffocation and perhaps to death. Acute edema of the glottis should always be considered as a possibility. Rough bodies may give rise to the same symptoms as those present following the swallowing of smooth objects. Added to the above are the complications arising from the mechanical irritation of rough edges; hence it is that, so often, pressure necrosis with perforation causing periesophageal inflammation with abscess formation is observed. Perforation may extend into the trachea or mediastinum, causing pneu-

monia, purulent bronchitis, pericarditis, pyopneumothorax, and perichondritis of the larynx. Induration of the neck accompanied by the general symptoms of sepsis, plus the symptom-complexes of the various complications, are present.

Ulcers

The etiology of this lesion of the esophagus is varied and should be divided into (1) the *inflammatory type*, due to mechanical, thermal, chemical or bacteriologic causes, (2) the *tuberculous*, (3) the *syphilitic*, (4) those *secondary to malignant tumors*.

Probably those most commonly observed are of the inflammatory group, following the swallowing of foreign bodies and the ingestion of liquids of very high temperature and of caustics such as lye and the various mineral acids. Local or diffuse infective inflammatory processes of the esophageal mucosa are at times etiologic factors. So-called "peptic ulcers" of the esophagus find their causes in increased acidity of the gastric and esophageal secretions.

A tuberculous process extending from the bronchial glands or larynx may, by direct invasion, involve the esophagus. The depositing of swallowed tubercle bacilli upon some eroded surface of the esophageal mucosa may cause a tuberculous ulcerative condition.

Syphilitic ulceration is not uncommon and exhibits itself as a gummatous infiltration and ulceration of the lower part of the pharynx and upper esophagus.

Carcinoma and, very uncommonly, sarcoma are causes for esophageal ulceration, either by direct extension from without, or by degeneration of a malignant tumor of the esophagus itself. The symptoms are varied, depending upon the etiology, the extent of the process and the amount of acute inflammatory material present. Dysphagia and pain upon swallowing are the two most constant symptoms. If the ulceration has invaded a blood-vessel there is a possibility that the vomiting of blood may be an added sign. Pain, especially in tuberculosis, may be entirely absent or may be present with marked severity. Interpretation with an esophagoscope may confirm the diagnosis.

Strictures

Strictures are *congenital* or *acquired*. Those acquired are due to (1) external causes, (2) internal causes, (3) hypochondriasis. External causes include injury, inflammatory infiltration or abscess in some surrounding tissue, pressure from diseases, lymph-nodes, such as tuberculosis, Hodgkin's disease and malignancy, a growth of the thyroid gland, or mediastinum, aneurysm of the arch of the aorta, pericardial effusion, deformities of the spine and an esophageal diverticulum. The internal causes include the ingestion of caustics, the varied inflammatory conditions, tuberculous and syphilitic ulcerations and malignant tumors. Hypochondriasis causing an esophageal spasm is a well-known etiologic factor. The severity of the symptoms are usually in direct proportion to the amount of stenosis present. The general trend of untreated true strictures is toward progression rather than retrogression, though there are certain types of esophageal stenosis which, though untreated, have a disposition toward improving and perhaps entirely clearing up. Thus many of the acute inflammatory conditions which may rapidly cause an acute edema

of the esophageal mucous membrane and attended with the most extraordinary and severe symptoms of stenosis, will subside within a short space of time; this, too, applies to those stenoses brought about by nervous conditions such as hysteria and hypochondriasis, the latter group appearing at intervals, the former showing no proclivity to return, once the exciting cause is removed. A true stricture, on the other hand, shows no tendency toward improvement without treatment and hence we have a series of symptoms, which though mild at first, may assume the most serious aspects. Progressive dysphagia, increased salivation, immediate or latent regurgitation of food, with a gradual emaciation and anemia form a *symptom-complex* of an esophageal stricture. Radiographic examination is of the utmost importance.

Dilatation

Dilatation always occurs above strictures of long standing and may be found in those patients who have intercurrent attacks of cardiospasm or spasm of the lower end of the esophagus. Regurgitation of food soon after eating or several hours later is the most constant symptom, preceded usually by a feeling of oppression in the thorax which is relieved by vomiting. The individual eats his food slowly and drinks much fluid to wash down the food, and often shows extraordinary signs of distress, exhibited by gulping, contortions of the arms and neck, with an attempt at deep breathing. When the regurgitated food appears in the vomitus it is devoid of hydrochloric acid but usually contains lactic acid. Radiographic examination is helpful in the making of a diagnosis.

Diverticulum

Diverticulum is *congenital* and *acquired*. The latter group are due to cicatrices resulting from inflammatory conditions of the esophagus or neighboring structures, from trauma to the wall of the esophagus and to frequent gagging or vomiting. The symptoms vary in accordance with the location of the affection. If situated in the upper portion of the esophagus the symptoms relate most especially to the regurgitation of food, and to neck swelling. The vomiting may be excessive or of a mild nature, after eating, with regurgitation of quantities of mucus into the pharynx. The vomitus may contain food eaten several days before. A deep fluctuant swelling in the neck accompanied with a sense of pressure and discomfort after eating is an almost constant symptom, and it is noteworthy that the neck swelling may be reduced by pressure with the expulsion of its contents into the pharynx. With these discomforting symptoms, the appetite may remain good and there may be no apparent gastric distress. Diverticula in the lower portion of the esophagus may give rise to symptoms so confusing as to tax the best. A sense of oppression after eating, together with increasing difficulty in swallowing, with vomiting, may arouse our suspicion. Anemia and loss of weight and strength are almost constantly present. A radiograph will in most cases confirm the diagnosis.

Spontaneous Rupture

Spontaneous rupture may be occasioned by violent shocks to the body, as jumping or falling from a height, and by excessive and violent retching or vomiting. The

symptoms usually come on very rapidly, including a sudden and violent pain in the neck, thorax or upper abdomen (especially epigastric region); soon followed by subcutaneous emphysema at the root of the neck, dyspnea and cyanosis. The pulse becomes very rapid and feeble, hiccough, extreme thirst, perhaps the vomiting of blood followed within forty-eight hours by utter collapse and death; this is the typical *symptom-complex* of the above affection. It should be remembered, however, that at times the rupture is minute and may heal spontaneously.

Perforation

Perforation is more commonly found than is spontaneous rupture, though it is a very rare condition. Its etiology is extensive and includes the swallowing of foreign bodies or caustics, efforts to swallow food in cases of stricture, the various ulcerative conditions of the esophagus, malignant tumors of the esophagus or of neighboring structures and organs, acute and chronic inflammatory conditions of, or about the esophagus, tuberculosis of the bodies of the vertebrae or of the superior bronchial lymph-nodes, aneurysm of the aorta or of other large vessels, and abscesses of the lung, or an empyema. The symptoms are those of rupture plus those referable to the etiologic factor.

Spasm

Spasm is not an uncommon condition, and is usually observed in the neurotic or hysterical young woman, though men are, at times, affected. Occasionally it is due to a reflex, referable to an inflammatory, ulcerative or malignant condition within or about the esophagus. A sense of pressure and of fullness after eating relieved by vomiting; dysphagia; the globus hystericus, a neurotic nature and the almost constant relief upon passing the esophageal bougie, generally make up the *symptom-complex* of this affection.

Varix

Cirrhosis of the liver or pressure upon the portal vein from some definite cause are the etiologic factors always considered with the above condition. The vomiting of small or large quantities of a bright red blood in an alcoholic, or in one affected with cirrhosis of the liver or with a malignant condition causing pressure on the portal vein, always points to a varix. It is not an uncommon condition. See "Hematemesis."

Fissures

Fissures appear within cicatricial strictures and may be brought about by the same conditions which cause "strictures." Indefinite pains during and after eating and upon the introduction of a sound or bougie may aid us in the diagnosis. The esophagoscope may establish the diagnosis.

Tumors

BENIGN

Cysts are of uncommon occurrence in this region and when present usually have developed from a diverticulum. Slight or severe difficulty in swallowing, at times

a palpable and movable tumor in the neck, possibly vomiting and occasionally the regurgitation of food may accompany the condition. In the more severe cases choking and asphyxia are present.

Papillomata may give rise to the same symptoms as cysts, fibromata and fibromyomata and lipomata plus the symptom of *hematemesis*. A palpable tumor mass in the neck is, however, never observed.

Fibromata and fibromyomata cannot be differentiated clinically from cysts and lipomata and give rise to the same symptoms, minus the vomiting of blood which is rarely, if ever, present in these conditions. A protrusion into the pharynx or from the oral orifice will occasionally enable one to differentiate the condition.

Lipomata.—A definite diagnosis can only be made macroscopically or microscopically. Clinically they are the same as are the fibroma.

Angiomata give rise to the same symptoms as do the papillomata.

MALIGNANT

Sarcoma of the esophagus is extremely rare either as a primary or secondary affection. "But one case of primary lymphosarcoma has been observed; secondary cases are reported by Schlagenhauffer" (*Keen's Surgery*, W. B. Saunders Co., Philadelphia, 1910, Vol. III, p. 809). The symptoms are those of any other obstructive growth, though rapidity of growth with rapid invasion is noteworthy. Examination with the esophagoscope and subsequent examination of the tissue microscopically will make the diagnosis. Keen states that sarcoma of the esophagus is usually found in old people and is most frequently located at the entrance of the esophagus or opposite the bifurcation of the trachea.

Carcinoma is not of infrequent occurrence and is usually observed as an extension from surrounding structures. At times, however, primary carcinomata appear. This type of malignant tumor is most frequently encountered opposite the bifurcation of the trachea, in the distal portion of the esophagus and in the neck. The most important etiologic factors are that males of over fifty years of age are most frequently affected; that chronic irritation of some type, whether it be chemical, thermal or mechanical or from alcohol or tobacco, are prominent causes; that ulcerations, both tuberculous and syphilitic, are perhaps exciting factors and that for some unknown reason strictures, diverticula and dilatations are likely zones for carcinomatous change. The symptoms are progressive, starting with perhaps a slight difficulty in swallowing accompanied by more or less pain and discomfort with a small amount of blood vomited or expelled, from time to time. As the condition advances the dysphagia becomes more pronounced, the pain sharper in character, increased by swallowing, and referred to the back, the root of the neck and to the epigastric region. Thirst becomes intense; regurgitation of food is almost immediate, if the tumor is high up, and after a longer period, if it is low down. Blood is mixed with the food or severe hematemesis may ensue. As the process advances pressure upon the cervical sympathetic may give rise to symptoms such as drooping of the eyelid, contracted pupil with sluggish reaction and at times retraction of the globe. Severe dyspnea may be present. The regional glands become enlarged and emaciation and cachexia appear. Perforation with its concomitant signs and complications is not infrequent.

CHAPTER VII

THE MALE GENITO-URINARY TRACT

AFFECTIONS OF THE KIDNEY

Congenital anomalies	{	absence of one kidney rudimentary development congenital displacement fused or horseshoe kidney																								
Injuries	{	<table> <tr> <td>wounds</td><td>{</td><td>crushing stab gunshot</td></tr> <tr> <td>contusion</td><td></td><td></td></tr> <tr> <td>laceration</td><td></td><td></td></tr> <tr> <td>rupture</td><td></td><td></td></tr> <tr> <td>aneurysm of renal artery following injury</td><td></td><td></td></tr> </table>	wounds	{	crushing stab gunshot	contusion			laceration			rupture			aneurysm of renal artery following injury											
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Inflammatory conditions	{	<table> <tr> <td>pyelonephritis</td><td></td><td></td></tr> <tr> <td>pyonephrosis</td><td></td><td></td></tr> <tr> <td>abscess</td><td></td><td></td></tr> <tr> <td>pyelitis</td><td></td><td></td></tr> <tr> <td>perinephritic abscess</td><td></td><td></td></tr> </table>	pyelonephritis			pyonephrosis			abscess			pyelitis			perinephritic abscess											
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Granulomata	{	tuberculosis syphilis (gumma) actinomycosis																								
Circulatory disorders	{	<table> <tr> <td>chronic passive congestion</td><td></td><td></td></tr> <tr> <td>renal infarct</td><td></td><td></td></tr> <tr> <td>aneurysm of renal artery</td><td></td><td></td></tr> <tr> <td>so-called "bleeding kidney"</td><td></td><td></td></tr> </table>	chronic passive congestion			renal infarct			aneurysm of renal artery			so-called "bleeding kidney"														
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Tumors (<i>cont.</i>)	{ malignant	{ hypernephroma carcinoma (of parenchyma) epithelioma (of pelvis) sarcoma endothelioma (often malignant)
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The kidneys lie against the posterior abdominal wall on each side of the spinal column. They are normally about 4 inches long, $2\frac{1}{2}$ inches in breadth and 2 inches thick. The upper end of the left kidney is in contact with the spleen, the right with the liver.

Examination of the kidney should begin with inspection, which is of value only if the organ is enlarged. The patient should lie in the dorsal decubitus completely relaxed, should breathe slowly and deeply and may flex the knees. If there is enlargement of the kidney, the lumbar region will show a change in conformation and a visible mass may project into the flank. With extreme enlargement, the costal border may be lifted up and either the cecal or sigmoid region distended; the mass may extend as far as the midline. There may be an edema of the lumbar region which will indicate perirenal abscess.

Palpation of the kidney is of greatest value in the examination. The patient should lie in the dorsal position similar to that used in inspection. The organ cannot be felt unless it is enlarged or displaced, since it lies entirely beneath the ribs. Palpation may be made by *Guyon's procedure*, which is simple palpation of the region followed by bimanual examination, one hand anterior, the other posterior, so that a ballottement may be discovered. Palpation may be made in the lateral position by *Israel's method*. This is similar to Guyon's method in that the organ is rolled between the two hands. In *Glenard's procedure*, one hand grasps the entire thickness of the abdominal wall at the lower costal margin in an attempt to grasp the kidney. The opposite hand aids in pushing the kidney into the grasp of the first hand. By these methods the kidney may often be palpated.

By palpation the points of tenderness may be made out. Posteriorly, there is the costovertebral point, located at the angle between the last rib and the spinal column, and the costomuscular point, located at the angle formed by the sacrolumbar muscles with the last rib. Anteriorly, the following points are to be determined: Infra-costal point, situated at the tip of the tenth rib just below the costal margin; the para-umbilical or supra-ureteral point located on a horizontal line passing through the umbilicus just lateral to the rectus muscle; the middle ureteral point lying over the entrance of the ureter into the pelvis and situated at the outer third of the horizontal line joining the two anterior superior iliac spines. Inferiorly the vesico-vaginal or vesicorectal point should be determined. This corresponds to the region where the orifice of the ureter enters the bladder, and is determined by palpation through the vagina or rectum. *Pasteau's point* or the supra-intraspinous point is located just above and medial to the anterior superior spine of the ilium. Pressure here is exerted on the external cutaneous nerve and points reflexly to a kidney disorder. The lateral supra-iliac point is situated 1 centimeter above the middle of the iliac crest and corresponds to the point of issue of the perforating branch of the last intercostal nerve.

Percussion of the kidney is of value in determining enlargements but, due to the relations, great care must be used. As a rule, the kidney is separated from the ante-

rior abdominal wall by a zone of resonance which is seldom absent even when the kidney is occupied by a tumor mass.

Finally, the examination of the kidney should be made radiographically after the intestinal tract has been thoroughly evacuated.

History

Age; Sex; Occupation

Family History.—Tuberculosis, cancer and other tumors, syphilis, kidney diseases, sudden deaths.

Personal History and Present Illness.—Alcoholic; venereal, including history of stricture (or inflammation of bladder). History of instrumentation. Injury. Frequency of urination during day and night, general appearance of urine passed. Is pain present during urination? Blood in urine (quantity, constant or intermittent). Attacks similar to present illness. Pain: radiation and character. Is it relieved by posture or the passing of large amounts of urine? Is bleeding relieved by rest in bed? History of passing of stones in urine; dizziness, anuria, night-sweats, cough and expectoration. Has mass been noted by patient and for how long a time? Vomiting, indigestion, chills and fever. Date of onset and character.

Physical Examination.—Presence of edema, tumor mass in kidney region. Pain and rigidity over costovertebral angle, or in any part of kidney region. Tenderness over course of ureters. Is mass, if present, tender on palpation and does it move with respiration; is it fixed or can it be easily moved? Contour and consistency of same. Signs of inflammation about the perinephritic region. Examination of urine. Inoculation of guinea-pig; bacteriology of urine, cystoscopic examination. X-ray, functional activity tests, blood-pressure. Primary site, if any, of affection. Leukocytic count.

INTERPRETATION OF HISTORY

Age.—Congenital anomalies, although present at birth, are not usually discovered until some superimposed condition arises. Polycystic disease of the kidneys, a congenital feature, is usually not made manifest until about the age of thirty-five. Sarcoma of the kidney occurs especially in infancy; tuberculosis is found, as a rule, in young adults; syphilis and actinomycosis in adult life. Pyelitis is quite common in infancy, less so in childhood and in advanced age. The circulatory affections are encountered especially about middle age, although they may occur earlier in life. Hydronephrosis, movable kidney, cystic affections and tumors in general occur in adult life. Calculus is seen in early adult and adult life.

Sex.—The male sex is more exposed to injury. Tuberculosis, pyelitis and hydronephrosis are more common in the female. Pyonephrosis, abscess, perinephritic abscess, the granulomata, other than tuberculosis, calculus and renal tumors occur principally in males.

Occupation is of importance in relation to renal injuries.

Family history has the same significance in kidney conditions as elsewhere.

Personal History and Present Illness.—*Alcoholic* excesses aggravate or produce a recrudescence of kidney infections, cystitis, stricture, and venereal disease. *Venereal* history relates to urethritis and syphilis. *Stricture, bladder inflammation* and *instrumentation* often precede an ascending affection of the kidney. *Injury* may cause contusion, laceration or rupture of the kidney. *Increased frequency of urination* occurs in calculus, kidney infections, chronic nephritis, tuberculosis, hydronephrosis, polycystic kidneys, parasitic affections and often in new growths. *Appearance of urine:* Urine may be hemorrhagic in calculus, tuberculosis, new growth, infarct and injury; cloudy (pus) in infections, tuberculosis. *Pain* varies with different conditions. Renal colic is present in those cases associated with obstruction of the ureter, such as calculus, new growth, movable kidney with twisted pedicle and ureteral stricture. *Dizziness, anuria* and *gastric symptoms* usually indicate impaired renal function. Anuria may exist during an attack of renal colic, particularly in Dietl's crisis. *Vomiting* also accompanies many cases of renal colic. *Chills and fever* indicate infection, or occur at times after instrumentation.

Physical Examination.—*Edema* of the loin, lumbar region or anterior abdominal wall may be noted in polycystic kidney, tuberculosis, new growth, perinephritic abscess, hydronephrosis and cystic infections. A *mass* is often palpated in injuries of the kidney, abscess, the malignant tumors and occasionally in the cystic conditions. In a really movable kidney, wide excursions of the kidney may be noted. The characteristics of a mass are best elicited by "*dipping*" and by *bimanual palpation* which is carried out with one hand in the costovertebral region, and *unilateral palpation* with the thumb in front and the fingers in the lumbar region. *Pain* and *rigidity* occur in the various types of infection, including perinephritic abscess, following injury, and frequently during attacks of renal colic from any cause; also, with aneurysm and infarct. *Costovertebral rigidity* and *tenderness* are significant of an infectious process. *Tenderness* is, as a rule, present in the same conditions as mentioned above. Respiratory mobility of the kidneys is distinctly limited. *Cystoscopy* with *ureteral catheterization* is essential in determining the source of bleeding or of pus, the condition of the bladders and ureters, and the location of *calculi*; and in obtaining individual specimens from each kidney for routine examination, functional tests and bacteriology; a *cystoscopic* examination is often advantageously combined with *radiography* and *pyelography*. A *bacteriologic* examination and *guinea-pig inoculations* are employed to determine the presence of a causative organism. Functional activity tests, from a practical standpoint, are limited to the phenolphthalein and the Mosenthal tests. The former can be carried out on each kidney while ureteral catheters are in position. *Blood examinations* are made for the determination of urea, creatinin and sugar, and for the white blood-cell count. *Blood-pressure* observations are made, for the readings are usually elevated in cases of chronic nephritis and renal artery aneurysm.

General Considerations

The kidneys are highly specialized vascular organs, histologically intricate, and of first importance in the eliminative functions. Their minute structure may be

easily affected and impaired by the toxins of general or local diseases and infections, by chemicals gaining access to the body in various manners, by the products of metabolism and by alterations and degenerative changes in the circulatory system. Hence, the surgeon is concerned with the possibilities of toxic nephritis, renal congestion, kidney infections and impaired renal function, as complications of operative procedures, and is always confronted by the preoperative possibility of acute or chronic nephritis. In the field of genito-urinary surgery, there are numerous considerations other than the above mentioned. First of all are the congenital anomalies, a glance at which will reveal the possibilities of error and confusion. Always there is the problem of obstruction at any point in the genito-urinary tract below the level of the kidney. Frequently, there is the question of infection, alone or in conjunction with other conditions such as a calculus or stricture. Comparative renal function, by which is meant the estimated ability of each kidney, must always hold an important place. Also, the general physical condition of the patient frequently bears some relation to the diagnostic and surgical phases.

There are now available various means of thoroughly investigating renal and ureteral affections. Certain routine lines of procedure will greatly simplify matters and yield the best results. First in order is the history, then a complete physical examination, followed in the majority of cases by radiography and cystoscopy with catheterization of the ureters.

Congenital Anomalies

Congenital Absence of One Kidney.—This condition is of the greatest surgical import, and one which, although comparatively rare, is encountered with sufficient frequency to make it imperative that the operating surgeon assure himself that one kidney is not congenitally absent. Related in significance is the possibility that one kidney is *rudimentary* in its development, the bulk of the excretory function being borne by the corresponding organ, which may or may not compensate for the deficiency of the improperly developed kidney.

Congenital Displacement of a Kidney.—This anomaly is of interest from the standpoint of differential diagnosis. In this condition, a mass having the characteristics of a kidney is palpated in the abdomen or pelvis at any level below the normal kidney fossa. It differs from the secondarily displaced or movable kidney by the feature that it is a fixed mass, the ureter on that side being shorter. Cystoscopy and pyelography should be utilized as adjuncts in the correct interpretation of the physical findings.

Horseshoe Kidney.—This is another congenital anomaly, and occurs from fusion of the kidneys across the median line of the body, the fused portion lying in front of the bodies of the vertebrae, with a lateral mass on either side. The occurrence of this condition is rare, and yet its presence should always be considered a possibility. The physical findings are usually negligible, hence the value and importance of accessory methods of investigation.

Injuries

(See "Abdominal Injury.")

Inflammatory Conditions

Pyelonephritis represents an extension of an inflammatory process from the pelvis to the renal parenchyma. Involvement of the kidney substance is indicated by the presence of albumin and casts in the urine, together with numerous pus cells, particularly those in clumps. The symptoms and signs are similar to those of pyelitis, which will be considered later on in this section.

Pyonephrosis.—In this serious affection, sometimes styled *surgical kidney*, the renal parenchyma is invaded and destroyed by pus-producing organisms whose activities result in multiple abscess production. It arises most frequently as a complication of lower urinary tract obstruction, as by calculus, new growth, enlarged prostate, urethral stricture, pelvic tumors and the pregnant uterus, and may also occur secondarily to cystitis, pyelitis, instrumentation and infections in other portions of the body. Patients complain of frequent, painful or burning urination, loss of appetite and strength, and attacks of abdominal or lumbar pain, varying from a dull ache or dragging sensation to severe pain, sometimes of the renal colic type. Recurrent chills and fever are frequent and the urine contains pus in large quantity. In suitable subjects an enlarged and tender mass may be palpated in the kidney region. In the late stages, the mass often assumes large proportions, appearing in both the loin and abdomen, and ranging in consistency from that of a normal kidney to one of actual fluctuation. During the acute attacks of pain, muscular rigidity and tenderness often mask the presence of an enlarged kidney, but, fortunately, these signs are usually most evident in the costovertebral angles, so that repeated urinary examinations should be made. The important elements in diagnosis are the history of a probable cause of kidney infection, the clinical evidence of concealed pus, the detection of tenderness and sometimes muscular rigidity, an enlarged and tender kidney and the urinary findings. Cystoscopy and radiography, with or without pyelography, are also indicated.

Abscess of the kidney generally arises after injury, penetrating wounds and septic infarcts. The symptoms are those of sepsis, such as chills, fever, loss of weight, gastric disturbances, together with severe pain in the kidney region and pyuria. Muscular rigidity and tenderness are found in the kidney region and the kidney itself is tender and swollen. If the infection remains localized to the kidney, infiltration and edema of the perirenal region are lacking, so that the presence of a perinephritic abscess can usually be eliminated.

Pyelitis.—Pyelitis is a suppurative inflammation of the kidney, of bacterial origin, being either blood-borne and descending or an upward extension along the urogenital tract. It is a medical condition but also of interest surgically. The hematogenous infection may follow even mild infections anywhere in the body such as a tonsillar abscess. The pelvis and the renal parenchyma, alone or together, are involved. The disease is especially common in female children where the colon bacillus points to an urogenous extension. Strictures, cystitis and hypertrophy of the prostate favor the development of pyelitis. *Pregnant women are prone to this condition.*

There may be no changes visible in the kidney structure if the infection has been mild and of short duration, as occurs in an acute generalized infection. When changes are present there are multiple, minute abscesses in the renal parenchyma

which by extension and fusion develop into large abscesses. In the urogenous type the ureter and pelvis are distended, extension of the infection occurring to the pyramids and cortex.

Symptoms of pyelitis may arise suddenly with chills and high fever, giving all the characteristics of an acute infection. In children especially, the diagnosis may be delayed because no underlying condition will lead to a suspicion of the urinary tract. But the diagnosis can be made by a careful examination of the urine which is often decreased in amount, contains a large quantity of pus and bacteria and some red blood-cells. If the renal pyramids are involved, resorption is decreased and polyuria the result. Casts of pus cells indicate infection of the renal parenchyma. There is usually tenderness over the kidney region, at times mild pain. The condition may be so severe and acute that all the symptoms of an uremia will develop or a chronic form may continue for years. In such a case there are remittent fever, occasional rigors, general symptoms of suppuration and pus and bacteria in the urine.

Perinephritic Abscess.—The general symptoms, like those of pyonephrosis, indicate a septic process. The local symptoms in the early stages are more or less indefinite, consisting merely of discomfort and a sensation of vague pain referred to one of the upper abdominal quadrants, the loin or the lumbar region. In such cases, the only appreciable findings are muscular rigidity, the costovertebral location being most significant, and induration of the soft tissues or only tenderness upon pressure. The preceding history is of major value and such items as prolonged kidney infection, local injury (contusion or penetrating wound), infectious processes in other situations and preceding acute illnesses should be completely investigated. In the average course of the affection, edema, tenderness and induration appear in the loin and lumbar region; this process often progresses into a fluctuant and palpable, but rather poorly defined mass. These signs are sometimes accompanied by pyuria. The posture is often altered because of muscular spasm; pain becomes more marked, and movements of the trunk are limited by the associated fixation of the lumbar spine, this latter feature sometimes being of such extent that lateral or anterior deviation may be observed. When these findings are combined with the constitutional reaction and the increased leukocyte count, diagnosis is apparent. However, the course of a perinephritic abscess is not always so obvious, as the pus may burrow in directions other than posteriorly, becoming localized in seemingly remote locations. Thus, a retroperitoneal abscess, a subhepatic abscess, infrequently empyema, occasionally a psoas abscess pointing in the groin, and, fairly commonly, an abscess in Petit's triangle above the iliac crest, may arise as a sequence of an original perinephritic abscess.

Granulomata

Tuberculosis of the kidney occurs especially in young adult life after the age of twenty, and is more common in the female sex. It arises as a complication of pulmonary disease, from a tuberculous process elsewhere in the body or it may be of hematogenous origin. In the great majority of cases, the disease is unilateral at the onset, and for some time after; the ureter on the affected side becomes thickened and the bladder infected at the ureteral orifice and trigone,

before the other kidney is involved. It is also notable that the affected kidney does not become enlarged until the disease has progressed for some time, and that the enlargement at no time is marked. The commonest early symptom is increased frequency of urination, attention usually being called to the bladder rather than to the kidneys. The failure of the bladder remedies in the relief of symptoms is therefore a significant point in the history. On the other hand, hematuria may be the initial symptom. Soon weakness and lassitude and disturbances of digestion appear, and later pain, which varies from a lumbar aching sensation to severe attacks which may assume the renal colic type. The urine contains pus and usually blood-cells. The kidney may or may not be palpable; if so, there is tenderness upon pressure, especially during the painful attacks: or, striking the costovertebral muscles with the fist may elicit pain when ordinary digital pressure will fail. Cystoscopic examination reveals inflammatory changes about the mouth of the ureter on the affected side, and the urine obtained by ureteral catheterization for bacteriologic study and guinea-pig inoculation often shows the presence of tubercle bacilli. The phenolphthalein output on the affected side is decreased at times, and the thickened ureter may be palpated upon pelvic or rectal examination. The general examination of the patient to determine other possible sites of tuberculosis is very important. A tuberculous abscess may develop in the lumbar region, perhaps with sinus formation.

Gumma of the kidney is the only syphilitic affection of surgical interest. An enlarged, sometimes irregular kidney is palpated, resembling the features of new growth from which it must be differentiated by the history of the patient, the Wassermann reaction and therapeutic tests. In some instances the gumma extends to the perirenal tissues with secondary swelling in the loin, and, occasionally, sinus formation. Subjectively, the patient complains of dragging sensations or severe pain in the renal region. This is a rare condition.

Actinomycosis produces symptoms similar to the above. The kidney becomes enlarged and nodular, fixed to the surrounding tissues, and later involves these structures with abscess and multiple sinus formation in the loin, back or abdominal wall. The urine contains pus, and the ray-fungus may be obtained from it, or from the discharge at the sinus openings. Actinomycosis is a disease of adult life and occurs chiefly in farmers and grain handlers. It may affect the kidney primarily or secondarily.

Circulatory Disorders

Chronic passive congestion occurs in the course of cardiac diseases and is indicated by a limited output of urine which contains albumin in large amounts. While not a surgical affection, this type of renal congestion is of interest as a post-operative complication.

Renal infarct in the presence of a known producing cause is indicated by sudden sharp pains in the kidney region, followed by hematuria. In some instances pain is absent, the prominent symptom being bleeding. Upon examination, there is tenderness upon pressure of the kidney, at times associated with rigidity of the overlying musculature. Search should be made for the etiologic factor, such as endocardial disease, pneumonia or typhoid fever.

Aneurysm of the renal artery is a rare affection occurring as a result of

arterial disease or as a sequel of injury. In the latter case, a rapidly developing mass is observed in the kidney region, beneath the free costal margin and extending to the loin; the patient voids blood. Otherwise, the tumor is of gradual development, but definitely progressive in size and causes severe abdominal or lumbar pain or pain which radiates along the nerve trunks into the lower extremities. A bruit can be heard, but an expansile pulsation cannot always be identified because of its deep situation. In advanced cases the bodies of the vertebræ become eroded. Aneurysms occur mostly in males and in those with a syphilitic history. The mass is usually tense, suggesting a solid tumor. In all suspected cases of this disease, the various syphilitic tests should be made.

The so-called "bleeding kidney" gives rise to a condition known as *essential hematuria*. When all recognized causes of bleeding have been ruled out, this term is used to fall back upon to cover up lack of information. Often in men under thirty such a condition exists and operation will show perhaps only a few varicosities in the papillæ. The bleeding comes on spontaneously with usually a dull pain in the lumbar region. X-rays and complete examination of the urine, including guinea-pig inoculation are negative. Cystoscopic examination indicates the kidney from which the bleeding arises; otherwise it is negative. Pronounced secondary anemia may follow but the bleeding tends to spontaneously cease and the prognosis is good.

Movable Kidney

Movable kidney is often associated with visceroptosis, the more exact term *nephroptosis* being used when the kidney alone is involved. The kidney may be palpable, movable or floating, three degrees of the same condition. Often there are no symptoms, or a great variety are complained of by neurasthenic patients. There may be a dull pain in the lumbar region with a sense of dragging and discomfort. Associated with a movable kidney there are often acute attacks of pain in the right side, called *Dietl's crises*, attributed to twists or kinks in the renal vessels or ureter. The pain usually comes on after sudden exertion, as in the renal region, and may radiate along the ureter and to the back. The pain is often severe, accompanied by nausea and, at times, chills. Tenderness will be elicited over the affected kidney and a mass may be felt there. Urine will be scant and bloody. After a few hours at the most, the symptoms abate, and the mass disappears. Other attacks usually follow in a few days or weeks. It is uncommon.

Calculi

Calculi in the kidney give rise to many symptoms and abnormal physical findings. They occur more commonly in men and in those of sedentary occupations. A stone may be present for years without symptoms. When the calculus attempts to pass through the ureter, there is produced an agonizing pain termed *renal colic*. The pain begins in the kidney region of the affected side, passes along the ureter and to the testicle or inner surface of the thigh. The back and abdomen may be involved in the radiating pain. Nausea and vomiting occur in severe cases, with feeble, rapid pulse and collapse. Temperature may rise as high as 103°. There is a frequency in urination with passage of bloody urine, as a rule. Complete suppres-

sion of urine may occur with, rarely, death from uremia. Following the acute attack, there is persistent dull pain with tenderness over the affected kidney. Even when a stone remains in the kidney, it often gives rise to dull soreness in the back with mild pain radiating to the scrotum or thigh. Irritation of the bladder is common. Blood in the urine is usually in small amounts but often occurs over a long period, especially marked following exertion. Infection of the pelvis of the kidney is a common complication. There may be chills, and fever reaching from 104° to 105° , followed by profuse sweating. The urine, besides containing blood, will be loaded with pus and pelvic epithelium. The calculus can be demonstrated by radiographic examination.

Hydronephrosis

Hydronephrosis is a dilation of the pelvis and calices of the kidney as a result of partial obstruction to the ureter. There is a collection of non-purulent fluid within the pelvis, with atrophy of the kidney tissue. Among the causes for this condition are congenital malformation of the ureter, repeated twists of a kidney pedicle, obstruction in the urethra, bladder or ureter, by calculus, carcinoma, benign tumors, an exudate of a pelvic inflammatory disease, peritoneal bands, gonorrhea or tuberculosis. The symptoms will depend upon the rate of formation of the hydronephritic tumor. With slight obstruction there will be a slowly enlarging mass in the loin or upper abdomen which may be unnoticed until it is of considerable size and presses on neighboring organs. There will be a sense of weight and fullness in the loin, upper abdominal quadrants and groin with occasional pain radiating to the scrotum or thigh. Pressure on the stomach and intestines will give rise to indigestion, loss of appetite, nausea, vomiting and constipation. The tumor may increase in size, so that it occupies nearly the whole side of the abdomen as a rounded, elastic, more or less tense swelling. The tumor is nearly always tender on deep palpation, a differential point from a new growth. Hypertrophy of the opposite kidney prevents the onset of uremic symptoms but when both kidneys are affected, the patient will die in an uremic coma. Intermittent hydronephrosis occurs when the obstruction increases and then lessens. Tumor and pain in the loin, accompanied by oliguria, occur, persist for a few hours, or days, then suddenly disappear and the patient passes a large quantity of urine. A typical Dietl's crisis may interrupt a quiescent condition.

Cysts

Cysts of the kidney are of a great number of varieties. *Simple cysts* are not common. They occur in adult life, are usually single, but may be multiple. During postmortem examinations, especially in the aged, they may be found unexpectedly. Their origin is probably in retention cysts of the glomeruli. They occupy one pole of the kidney, are thin walled and filled with a watery, albuminous fluid rather than urine. In size they are usually that of an olive but much larger ones have occasionally been reported. Symptoms, if present, are due to mechanical interference. A dull ache and a smooth, elastic tumor may be present in the loin. The urine will be entirely normal. Ureteral catheterization may be necessary to differentiate a hydronephrosis. *Parasitic cysts* due to the echinococcus are usually single, with

a wall increasing in thickness as the cyst increases in size. Rupture into other organs following adhesions or into the kidney pelvis may occur. The urine will contain hooklets or vesicles. This condition is found in the tropics and Far East, but is extremely rare in the United States. *Pararenal cysts* of unknown origin have been found but are diagnosed clinically as hydronephrosis. *Polycystic kidneys* are often bilateral and congenital, often three or four times the normal size of a kidney and made up of a multitude of intercommunicating cysts. The symptoms are often indefinite, and are caused by pressure upon the neighboring tissues. The diagnosis is often made only at autopsy, after death has resulted from uremia. The urine may be normal, but it is increased in quantity at intervals, with the presence of albumin. The condition is slowly progressive and may last for many years.

Parasitic Affections

Parasitic affections of the kidney are not common. For echinococcus disease, see above. *Filaria sanguinis hominis* will often cause the passage of opaque, white, milky, bloody or chylous urine. Several weeks may pass in which the urine is normal and it is surprising how long these patients remain in good health. When present in the body *Eustrongylus gigas* is usually found in the kidney, at times seeming to cause no damage but usually leading to cystic degeneration with pus-filled cavities. Severe pain in the groin and hematuria may be present. *Distoma hematobium* (*Bilharzia*) affects the kidney chiefly by preventing a free outflow of urine. An hydronephrosis or pyonephrosis results.

Tumors

Benign tumors of the kidney are occasionally encountered. The most common is *adenoma*. *Papilloma*, *fibroma*, *angioma*, *lipoma*, *myoma* and *rhabdomyoma* also occur, but are extremely rare. They are usually so small that they give rise to no definite symptoms and do not require removal. Hematuria is rarely present.

Malignant tumors of the kidney may be hypernephroma, carcinoma or sarcoma. A *hypernephroma* is a growth of aberrant adrenal tissue within the kidney substance. It metastasizes early to the lung, liver or long bones. The metastases may give the first symptoms. The symptoms of all the malignant tumors are very similar, it usually being impossible to differentiate, clinically, between them. Symptoms may be delayed but when once manifest, they usually grow rapidly more severe until death ensues in one to three years. *Hematuria is the most important finding*. It occurs early, is persistent and increasing in amount. A mass in the loin is rarely found until late in the disease. Pain is a variable symptom, usually a dull ache in the loin but occasionally of a severe colicky nature. With severe pain, tenderness is present. The urine besides containing blood may show pus and albumin. At times cells of the new growth may be found. Pressure symptoms on the surrounding organs may cause much distress. Blood-pressure readings usually show a definite rise. This is not constant, but is often found in this condition and some significance should be attached to it. An *endothelioma*, in very rare instances, may occur and assume the clinical characteristics of a malignant tumor.

AFFECTIONS OF THE URETER

Congenital anomalies	{	absence of ureter double pelvis double ureter fused ureters abnormal ureteral opening
Injuries		
Inflammatory conditions	{	pyelitis ureteritis
Tuberculosis		
Obstruction	{	stricture hydro-ureter diverticulum torsion calculus spasm
Tumors	{	benign { papilloma myxoma myoma malignant { carcinoma angiosarcoma endothelioma (at times benign)

Congenital Anomalies

These conditions are only occasionally found, but are of great variety. *Absence* is rare. *Supernumerary* ureters occur in about 3 per cent of cases, according to Poiser. The condition is most often unilateral and so placed that it drains the upper part of the kidney. The extra ureter alone may be diseased. *Abnormal endings* are most common in the prostatic utricle and on the anterior vaginal fornix. The lower end may form an intravesical prolapse.

Injuries

Injuries to the ureter occur in stab or gunshot wounds or during surgical operations. They are rare but when present simulate injury to the pelvis of the kidney.

Inflammatory Conditions

Inflammations of the ureter are rare. See under "Kidney" for *pyelitis*. *Ureteritis* may follow an injury, impacted stone or extension from some other part of the urinary tract. There are no characteristic symptoms; pain resembling renal colic is the most important. Symptoms of the primary inflammation in some neighboring organ will usually overshadow the ureteritis.

Granuloma

Tuberculosis of the ureter is a secondary descending process from an infected kidney. Symptoms are similar to those arising in the kidney.

Obstruction

Stricture of the ureter is a fairly common condition, first and most completely described by G. L. Hunner of Baltimore. He believes that focal infection is the chief etiologic factor, others being congenital malformations, calculus, tuberculosis, gonorrhea and adhesions resulting from labor or surgical operations. The condition is most common in the fourth decade, and about twice as frequent in females as in males.

The symptoms arising from stricture are either indefinite, or similar to those from stones. Pain is the most universal complaint but varies from a vague discomfort to colicky attacks running along the ureter and perhaps into the testis or labium of the corresponding side. Hunner says the pain may be present in any region from the diaphragm to the ankles. Irritability of the bladder with frequency and dysuria are secondary symptoms but the urine is usually negative until late in the disease when it may contain blood, pus and bacteria. Hematuria may be the original complaint. Fever may be present if the stricture closes, even if there is no infection. Gastro-intestinal symptoms are common, varying from loss of appetite to vomiting, gaseous distention or rectal tenesmus. Headaches are a frequent complaint.

Examination for stricture should begin with a general physical examination. The kidney and entire length of the ureter should be palpated, the lower end by vagina or rectum. Church was able to reach a probable diagnosis in nearly half of his cases by physical examination alone. Cystoscopic examination is of little value unless there is a secondary cystitis or an ulcer or stricture is near the ureteral orifice. On catheterizing the ureter there may be found a narrowing, constriction or resistance. Of more value is pyelography in which the ureter is injected with sodium iodid or sodium bromid; a radiogram then shows kinks or narrowings. Hunner advocates the use of a wax-tipped catheter with a wax bulb about an inch from the tip. The resistance of the stricture on the bulb is diagnostic and a scratch on the surface will indicate a stone. It must not be forgotten that difficulty in passing a ureteral catheter may be normal, due to spasm, angulation or the tortuous course of the ureter.

For references on stricture of the ureter see page 273.

Hydro-ureter may be caused by a diverticulum, torsion, calculus, spasm or tumor.

Diverticulum is rare.

Torsion is caused by the sinking of a movable kidney and fixation of the upper part of the ureter by adhesions, physiologic or pathologic.

Calculus in the ureter is formed in the kidney and becomes impacted at some narrow point, just below the renal pelvis, at the middle part or at the entrance into the bladder. With complete blocking there will be anuria; with partial obstruction there will be severe colicky pain radiating along the course of the ureter to the external genitalia or thigh. Hematuria will be present. Cystoscopy, ureteral catheterization and radiography are helpful and should be used in every suspected case.

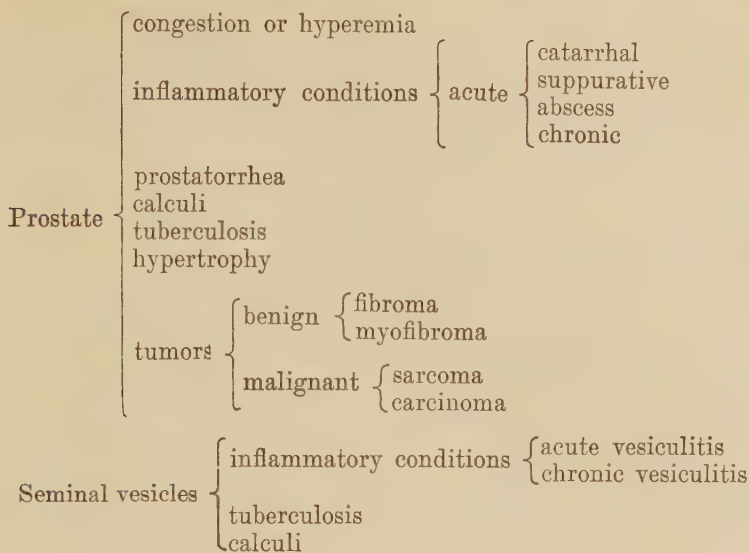
One should always bear this condition in mind when making a probable diagnosis of acute appendicitis.

Tumors

Primary tumors of the ureter are rare. The most common are *papilloma* and *caruncle*. The caruncle is a localized inflammatory hypertrophic or angiomatous growth of the mucosa, often projecting from the meatus. It is usually bright red, varies in size from that of a millet seed to a hazelnut, may be sessile or pedunculated, single or multiple, simple or neuromatous. There may be no symptoms but the neuromatous type is very painful so that urination and coition are interfered with. Even locomotion or the pressure of the clothing may be unbearable. Hemorrhage from the caruncle is common. The diagnosis is easily made by inspection. *Myxomata* and *myomata* have been described, followed by papillary carcinoma. Hematuria is an important sign; it may be present over a long period of time and give rise to long, castlike clots. Pain will be of a dull ache in the loam or of a severe nature resembling renal colic. X-ray and cystoscopy should be employed.

AFFECTIONS OF THE BLADDER, PROSTATE
AND SEMINAL VESICLES

Bladder	congenital anomalies	{	exstrophy		
			double bladder		
			diverticulum		
			congenital absence		
			umbilical fistula		
			persistent cloaca		
	atony				
	retention				
	vesical fistulæ				
	rupture				
	calculi				
	foreign bodies				
	varix				
	hernia				
	simple ulcer				
	granulomata	{	tuberculosis		
			syphilis		
	inflammatory conditions	{	acute cystitis		
			chronic cystitis		
	tumors (Kuster's Classification)	{	epithelial tumors	{	papilloma
					adenoma
					carcinoma
					dermoid cyst
		{	connective tissue tumors	{	myxoma
					fibroma
					angioma
	{	muscular tissue tumors	{	myoma	
	neuroses				



History

Age; Occupation; Nativity

Family History.—Tuberculosis, cancer and other tumors, syphilis, rheumatism and gout, “kidney and bladder stones” or other diseases of genito-urinary tract. History of hematuria.

Personal History.—Acute infectious diseases; tuberculosis, gonorrhea, syphilis, alcoholic history, history of masturbation or sexual excess, stricture and instrumentation; gout, use of irritating urethral injections or irritating drugs taken by mouth; renal or vesical colic, habit of bowels or the passing of stones or sand by urethra; trauma, sedentary habit, overuse of cathartics, kind of exercise including horseback or bicycling; sexual excitement without coitus; state of bladder before present condition; previous attacks similar to the present illness (symptoms, dates and duration), catheter life, spinal cord injuries and diseases.

Present Illness.—Prominent symptoms. Approximate date of first subjective symptoms. Type of onset, history of recent gonorrhea or gleet, recent debauches including venereal, alcoholic or both; chills, fever, recent instrumentation, exposure to cold. Injury.

Urinary Symptoms.—Since when has the amount of urine been increased or diminished; frequency of urination during day and night (is there a decided increase in the number of times of urination?). Is quantity increased during the day or night? Dribbling of urine (time of onset); change, if any, in size and strength of stream; difficulty in starting stream. Does stream ever stop suddenly during urination? Absolute retention. Blood in urine (constant or intermittent). Gross appearance of urine. Recent passing of sand or calculus (gravel).

Sexual Symptoms.—Painful erections, loss of sexual power, perversion of sexual desires, frequent erections, nocturnal emissions, sexual hypochondriasis and nervousness, precocious or painful ejaculations; imperfect erections.

Pain.—Acute, dull or both, original location and area of maximum referred pain, pain constant or intermittent, before, during or after urination; date of onset, if possible, of first attack of pain. Is pain increased by defecation? Is it increased or diminished by urination? Chronic or dull pain in rectum or perineum; is pain increased or diminished at night?

Signs of Infection.—Chills, fever, nausea, vomiting, malaise, loss of weight, night-sweats, cough and hemoptysis. History of renal colic.

Physical Examination.—General appearance of patient, inspection of rectum, buttocks and perineum for signs of fistulæ or excoriations; inspection of penis for urethral discharge and sores. Examination with cystoscope, searcher, sound or divulsor, x-ray, examination of urine, rectal examination for condition of prostate and perivesical tissue (smooth and nodular, stony, hard, boggy, soft or even fluctuant, free or adherent, signs of periprostatic induration). Examination of long bones for metastasis. Wassermann. Tuberculin. Hemorrhoids, rectal prolapse. Hernia. Temperature, pulse and respirations. Examination of heart and lungs. Palpation of testicles, epididymis, and inguinal glands. Leukocyte count and determination of blood-pressure. Rectal shelf.

INTERPRETATION OF HISTORY

Age

<i>Infancy and Childhood</i>	{	congenital malformations of bladder calculus (bladder) foreign bodies (bladder) cystitis sarcoma of bladder sarcoma of prostate
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<i>Young Adult Life</i>	{	tuberculosis of bladder cystitis sarcoma of bladder benign tumors of bladder acute prostatitis prostaticorrhea tuberculosis of prostate sarcoma of prostate inflammation of seminal vesicles tuberculosis of seminal vesicles
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<i>Adult Life</i>	{	atony cystitis benign tumors of bladder carcinoma of bladder acute prostatitis chronic prostatitis prostaticorrhea hypertrophy (benign) of prostate prostatic calculi tuberculosis of prostate sarcoma of prostate carcinoma of prostate
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<i>Advanced Age</i>	{	cystitis
		calculus (bladder)
		atony of bladder
		carcinoma of bladder
		chronic prostatitis
		calculi of prostate
		hypertrophy (benign) prostate
		carcinoma of prostate

Occupation.—Anilin workers (carcinoma of bladder and cystitis), and those in sedentary occupations (atony of bladder).

Nativity.—In certain districts, calculi are common.

Heredity.—Often considered as a predisposing factor, especially in bladder affection following the neuroses, spinal cord affections and tuberculosis, not perhaps as a primary lesion, but rather as a secondary manifestation. Rheumatism and so-called “uric acid diathesis” may influence the presence of bladder and prostatic calculi.

Personal History

Acute Infectious Diseases

Acute cystitis

Acute prostatitis

Periprostatic abscess

Gonorrhea

Acute and chronic cystitis

Acute vesiculitis

Chronic vesiculitis

Acute prostatitis

Chronic prostatitis

Benign hypertrophy of prostate

Periprostatic abscess

Indirectly, tuberculosis and malignant tumors of prostate

*Syphilis**

Syphilis of bladder wall

Retention, atony, neurosis of bladder and cystitis (tabes, sclerosis and gumma of spinal cord)

Alcohol.—Debauches have often preceded acute cystitis with urinary retention, and acute prostatitis. Alcohol may be an etiologic factor in chronic prostatitis and hypertrophy and in aggravating all forms of preëxisting cystitis.

Masturbation or Sexual Excess.—Vesiculitis; acute and chronic prostatitis; prostaticorrhea; tuberculosis; hypertrophy of prostate (benign and malignant) may be ascribed as a cause for any of the prostatic affections.

Stricture and Instrumentation.—Dirty and unclean instruments may cause acute and chronic cystitis, presence of foreign bodies in bladder, acute and chronic prostatitis, prostatic and periprostatic abscess. Hematuria and so-called “urethral fever” may follow a catheterization performed under aseptic conditions.

Gout.—Predisposes to cystitis, so-called “prostatic gout” and prostatic calculi and to prostaticorrhea.

* It should be borne in mind that any patient who has had a chancre (of penis) is likely to have had gonorrhea with its accompanying bladder disturbances.

Use of irritating urethral injections or irritating drugs may cause acute and chronic cystitis, acute prostatitis, chronic prostatitis, prostaticorrhea, hematuria (balsams, hexamethylenamin, etc.).

Renal or Vesical Colic and History of Passing Stones.—Predisposes or precedes cystitis; suggests possibility of bladder stone, acute and chronic prostatitis and prostate calculi.

History of Bowels.—Constipation may suggest an acute or chronic prostatitis. Disturbance of rectal function is often associated with retention and atony. Tenesmus is common in bladder calculus, acute cystitis, acute and chronic prostatitis, prostatic hypertrophy; prolapse of rectum is a very suggestive symptom of vesical calculus in a child. Pain upon defecation is significant of prostatic abscess.

Trauma.—Rupture or hernia of bladder with, perhaps, accompanying cystitis. Rupture of posterior urethra with accompanying prostatic inflammation.

Kind of Exercise.—Bicycling and horseback riding may be causative factors in acute and chronic prostatitis and benign prostatic hypertrophy.

Sexual Excitement without Coitus

Vesiculitis

Prostaticorrhea

Acute prostatitis

Benign prostatic hypertrophy

State of Bladder before Present Condition.—Ascertain habits of bladder before present illness.

Previous Similar Attacks

Cystitis

Bladder calculus

Vesiculitis

Acute prostatitis

Chronic prostatitis

Periprostatic abscess

Prostaticorrhea

History of Catheter Life.—Predisposes to cystitis, acute and chronic prostatitis and is indicative of some form of urinary obstruction.

History of Spinal Cord Injuries or Diseases.—May account for various disturbances of bladder function.

Present Illness.—*Several symptoms* aid in the differentiation of various conditions. These are pain or sudden painful urination, dribbling of urine, sudden stopping of stream, increased frequency of urination day or night, discharge from urethra, nocturnal emissions, impotence, urinary incontinence, prostaticorrhea, passing of sand and stones in urine, appearance of blood in urine, free urethral hemorrhage, inability to void, or rectal tenesmus.

Types of Onset.—SUDDEN

Acute cystitis

Probably bladder calculus

Rupture of bladder

Urinary retention

Acute vesiculitis

Acute prostatitis

Periprostatic abscess

Abscess of prostate

GRADUAL.—Other conditions of bladder, prostate, and seminal vesicles. At times, however, it must be considered that the diseases which are gradual in their course may give rise to acute symptoms.

Urinary Symptoms.—Frequency of Urination (Day and Night).—All bladder, seminal vesicle and prostatic diseases have a tendency toward causing frequent urination both day and night. It is, however, to be noted that in the presence of urinary and prostatic calculi this symptom is markedly increased in the daytime, and usually disappears during rest.

Dribbling is present in all conditions in which we have a marked retention with overdistention of the bladder, in those cases in which we have a destruction by malignancy of the sphincter muscle, or through disease of the central nervous system affecting the urinary mechanism. This symptom may occur in the presence of an hypertrophy of the median lobe of the prostate without marked retention.

Change in size and strength of stream occurs especially in tumors of neck of bladder and bladder calculi, in hypertrophies, especially of middle lobe of prostate gland, either benign or malignant, in foreign bodies in bladder, and at times in the prostate and bladder inflammations.

Difficulty in starting stream may be present in hernia of bladder, in the benign and malignant tumors of the bladder, in bladder calculi, in foreign bodies of the bladder; this symptom may also be observed as an early symptom of tuberculosis of bladder, the benign and malignant hypertrophies of the prostate, in tuberculosis of the prostate in which we have a marked enlargement, and at times in acute prostatitis and prostatic calculi. It is symptomatic of urinary retention, atony and rupture of the bladder.

Does stream ever stop suddenly during urination? This symptom is found especially in bladder calculi, foreign bodies in bladder, especially pedunculated growths of bladder, in any prostatic enlargement, especially of the middle lobe, occasionally in prostatic calculus, and in the prostatic inflammatory conditions.

Absolute urinary retention may be present in any condition of the bladder or prostate in which we have an interference, either mechanical or neurologic with the outflow of urine.

Blood in Urine.—See “Hematuria.”

Sexual Symptoms

Painful erections { vesiculitis
often in the prostatic hypertrophies
prostatic inflammations

Loss of sexual power
(not a constant symptom) { chronic vesiculitis
chronic prostatitis
prostatic hypertrophies

Perversion of sexual desires (often associated with chronic prostatitis and prostaticorrhea)

Frequent erections { chronic vesiculitis
early stages of tuberculosis of seminal vesicles and prostate
at times chronic prostatitis

Nocturnal emissions	{ acute vesiculitis chronic vesiculitis tuberculous vesiculitis chronic prostatitis occasionally, hypertrophy of prostate prostaticorrhea
Sexual hypochondriasis and nervousness	{ acute vesiculitis chronic vesiculitis tuberculous vesiculitis chronic prostatitis
Precocious or painful ejaculations	{ acute vesiculitis chronic vesiculitis acute prostatitis chronic prostatitis tuberculosis of prostate
Imperfect erections	{ chronic vesiculitis chronic prostatitis tuberculosis of prostate gland prostatic hypertrophies prostatic malignant tumors

Pain is present in practically all of the acute inflammatory conditions of the bladder, prostate and seminal vesicles. It is usually especially severe in the fulminating forms of acute cystitis and vesiculitis and in the presence of prostatic or periprostatic abscess. A burning pain in the hypogastrium during and after urination points to an acute cystitis; severe pain in the rectum or perineum, especially following urination and defecation is suggestive of an acute prostatitis or prostatic abscess. With chronic prostatitis the pain may vary from slight intercurrent spasms to severe attacks of pain referred over the whole genito-urinary tract, with backache, burning and pain in the rectum and especially frequent dull pain referred to the glans penis. Atony of the bladder with retention of urine causes dull pain in the hypogastrium. Rupture of the bladder gives no distinctive pain symptom because of associated injuries or complications. Pain is one of the most common complaints from a bladder calculus, the pain being referred to the penis, rectum, pubis or perineum, possibly radiating down the thighs, worse at the end of urination as the walls contract against the stone and considerably increased by exercise or jarring movements. Foreign bodies in the bladder may cause the same pain symptoms as a calculus. Varix of the bladder leads to pain only if there is difficulty in passing large clots of blood. Tuberculosis of the bladder causes pain similar to that of a cystitis, the pain being present during and at the end of urination and referred along the urethra or localized to the neck of the bladder. Malignant tumors of the bladder lead to pain when the usual secondary cystitis becomes established; the pain becomes excruciating in the neck of the bladder or perineum, often referred along the penis; pain on defecation indicates an extension to the perirectal tissues. Neuroses of the bladder may lead to complaints of any type of pain in that region. Calculi in the prostate may or may not be associated with pain. Tuberculosis of that organ has, as a premonitory sign, painful and frequent urination with indefinite pains in the posterior urethral region and painful defecation. As the condition advances the pain becomes more severe. Benign hypertrophy of the prostate leads to a

constant dull pain in the perineum; in an advanced case there is present the pain of an acute retention or of a cystitis. Malignant tumors of the prostate give rise to painful urination with early pain in the rectum, very severe on defecation, radiating down the thighs and along the course of the sciatic nerve. Acute vesiculitis causes pain referred to the rectum or perineum and aggravated by urination or defecation and always present on ejaculation.

Signs of Infection.—Occasionally in acute cystitis; calculus and foreign bodies with cystitis; following rupture of bladder; tuberculosis of bladder (often); acute prostatitis; abscess; periprostatic abscess; tuberculosis of prostate (occasionally).

Physical Examination.—*Inspection*

Fistula in perineum	{	etiology	{	bladder {	ruptured
				ulcerated	
				prostatic abscess	
				urethral stricture	
				periprostatic abscess	
				prostatic calculus with abscess	
				tuberculosis of prostate with ulceration	
				malignancy with ulceration	
Fistula in rectum (discharge in or about)	{		{	bladder {	ruptured
				ulcerated	
				prostatic abscess	
				periprostatic abscess	
				prostatic calculus with abscess	
				tuberculosis of prostate with ulceration	
				malignancy with ulceration.	
Urethral discharge	{			acute cystitis with its accompanying causes	
				tuberculosis of bladder	
				acute and chronic vesiculitis	
				urethritis	
Prostatorrhea	{			tuberculosis of prostate	
				possible malignancy of prostate with degeneration	

Cystoscopy and Use of Sound

Radiography often is an aid in the detection of calculus in the bladder and prostate.

Examination of Long Bones.—Especially to be noted in carcinoma of prostate—seldom in sarcoma.

Leukocytosis.—Increased in all of the inflammatory conditions.

AFFECTIONS OF BLADDER

Congenital Anomalies

Exstrophy of Bladder.—This is the most important congenital affection of the urinary bladder. It consists of a defect in the union of the anterior wall of the bladder and the tissues directly in front of it, including the anterior abdominal wall and the pubic bones, and oftentimes the superior portion of the penis. There is a visible cleft in these structures which is bridged by the posterior bladder wall,

and which is often continuous with an epispadias in the male, and with an abnormal separation of the labia in the female. The bladder surface is flush with the abdominal wall or bulges somewhat forward; is reddish in color and appears inflamed. It can be identified by locating the ureteral openings, from which urine escapes on to the abdomen and thighs, producing an offensive odor and excoriating the skin. Exstrophy is much more common in the male, and congenital hernia is frequently found in conjunction with it.

Double Bladder.—Cases of double bladder, each with its ureteral opening, have been observed upon cystoscopy. Similar anomalies of the uterus, vagina or penis are often associated.

Diverticulum, or congenital sacculation, of the bladder, can be diagnosed upon cystoscopy, where the condition appears rounded and well defined.

Congenital absence of the bladder is a rare condition in which the ureters open directly into the urethra, or into the vagina or rectum.

Umbilical fistula, from which urine drains on to the abdomen wall, is a congenital anomaly due to a patent urachus.

Persistent cloaca is a condition in which there is a preservation of the common opening of the bladder and rectum, as occurs during fetal life. It is rarely found.

Atony

This affection of the bladder is a state of inefficient muscular tone permitting the accumulation of urine with gradual increase in the size of the bladder. Atony is a symptomatic condition, and may not be painful. Thus, in the acute fevers, notably typhoid, and in such neurologic affections as tabes and myelitis, the bladder frequently becomes overdistended. Increase in size of the abdomen, pain and inability to void, or increased frequency are the subjective symptoms. Objectively, there is a rounded, tense tumor extending from the symphysis to any point above that level; it is flat on percussion. Upon catheterization the tumor disappears. Mechanical obstruction with frequent retention is a common cause of atony. Inflammation may also produce it. The postoperative atony of the bladder is familiar to all. In a certain class of people of sedentary occupation it is often habitual.

Retention

Retention of urine signifies that the bladder musculature is unequal to its function, allowing some of the urine to remain in the bladder after voiding. Patients with this mild grade of retention complain of a fullness in the pelvis after urinating. When the condition is more marked, atony occurs, and there is difficulty in starting the stream, or complete inability to urinate, with the gradual production of a tumor above the symphysis, which disappears upon catheterization.

Vesical Fistulæ

These may be tracts between the bladder and the skin, or between the bladder and an adjacent viscus. There are, then, several varieties, such as *vesicovaginal*,

vesicorectal, *vesicoperineal*, *vesico-abdominal*, and also the congenital type known as *patent urachus*. The fistula may be from the bladder, or into the bladder from another viscus. Thus, peritoneal or intestinal tuberculosis, penetrating wounds, malignancy, abscess, ulceration from calculi or foreign bodies, and operations, purposeful or accidental, may be the causative factors.

The origin of a bladder fistula may be recognized first, by the escape of urine by an abnormal route, as through a perineal sinus, the rectum or vagina; second, by the presence in the bladder of the products of other organs, as gas and feces; third, by visual observation, using the cystoscope in conjunction with probing of the sinus; fourth, if a colored solution is injected into the bladder it may be seen to escape from the suspected sinus. Clinically, an urethral fistula can be differentiated by the fact that urine only escapes therefrom at the time of voluntary urination.

Rupture

Rupture of the urinary bladder may be either intra- or extra-peritoneal, according to the site of the injury. It is produced by penetrating wounds occurring especially in association with fractures of the pubic bones. It is most likely to occur when the bladder is full, and is more common in males. Very rarely, it may be spontaneous, due to overdistention.

Shock may or may not appear at the time of injury. Subsequently, if the site of rupture is intraperitoneal, urine escapes into the peritoneal cavity and produces a reactive peritonitis, which is very severe. In extraperitoneal rupture, urine infiltrates the perineum, external genitalia and anterior abdominal wall; edema or brawniness in any or all of these situations develop, sometimes with abscess formation. Shortly after the injury the patient has severe pain in the pelvis and hypogastric region, and usually is anxious to urinate, feeling that this would relieve his pain. Occasionally a small amount of urine mixed with blood is voided, and leads to confusion. Pressure over the symphysis is painful, and there is spasm of the overlying muscles. Failure to void after an abdominal injury, unless the bladder had been emptied immediately before, calls for catheterization. During this procedure no urine whatever, or a small amount of bloody urine, is obtained. If a measured amount of sterile solution is injected into the bladder, only a portion or none of it will be recovered by catheterization in the ordinary case.

Calculi

Stone in the bladder, originating in that viscus or passed from the renal pelvis and retained in the bladder, is fairly frequent in children and may occur at any subsequent age. It may occasion no symptoms for some time. An inflammatory reaction gradually develops, so that increased frequency of urination is a fairly early symptom. Vesical and rectal tenesmus may be concurrent. Pollakiuria, like the pain of bladder calculus, is aggravated by exercise and jarring movement, and is therefore more evident during the day.

Pain or discomfort referred to the penis, rectum, pubis or perineum, and possibly radiating down the thighs, which is worse at the end of urination and considerably worse upon motion, is suggestive. As a result of the presence of a

foreign body there is cystitis, the urine containing pus and red blood-cells. A frank hematuria mixed with urine is not so common. In some patients during the act of urination there is a sudden interruption in the stream, with severe pain as the stone blocks the urethral orifice.

The patient may find it necessary to assume some unusual posture before urination is possible. Some patients complain of movement of some object within the bladder, this occurring when the stone is free and the bladder is full. Upon examination, a stone may be felt by rectum or vagina, or through the dilated female urethra. Often its presence may be demonstrated by the introduction of a metal sound, searcher or lithotrite. Cystoscopy and radiography are the most valuable agents in diagnosis, although there are certain sources of error in the former, and a soft stone may throw no shadow on a radiogram.

Foreign Bodies

Foreign bodies gain access to the bladder by means of gunshot wounds, perineal and vulval injuries of a transfixing nature, perverted sexual impulses, by the breaking of rubber catheters or other instruments, and through surgical operations. The symptoms vary according to the type of foreign body. Some may produce no symptoms, while sharp articles are likely to cause severe pain, particularly at the end of urination as the bladder contracts down upon them. In the later stages, the symptoms are those of cystitis or calculus, the foreign body becoming encrusted with lime or other salts. Also, in urination, a sudden interruption of the stream may occur, and ulceration with fistula formation may result. In regard to instrumentation, penetrating wounds and former operations, the history may be quite suggestive or even definite. When an article has been placed in the urethra through perversion, the act will probably be denied. Diagnosis may be made by cystoscopy, sounding and radiography.

Varix

Varix of the urinary bladder produces hematuria which is usually painless. If large clots are formed, there is pain upon attempts at their extrusion. The blood is mixed with urine if hemorrhage occurs while the bladder is full, or may be terminal, bright blood being passed at the end of urination. Cystitis symptoms may supervene. The diagnosis is to be made by cystoscopy.

Hernia

The presence of the bladder in a hernia occurs in a small proportion of inguinal hernias. It is found mostly in males, and particularly in cases of urinary obstruction of some nature. The swelling may appear at any point in the lower abdominal wall, but is most commonly situated just internal to the internal abdominal ring. It transmits an impulse and enlarges upon coughing. Bladder may be suspected to compose part or all of such a hernia when the patient gives the history of difficulty in urination, or when pressure upon the swelling incites the desire to urinate. Other patients will state that the bladder is not completely emptied

until manual pressure has been made upon the hernia. The mass often becomes smaller following urination. Without operative interference, the diagnosis of this condition can be accurately made by cystoscopy.

Simple Ulcer

Simple ulcer is a rare condition of the bladder which sometimes resembles in its symptomatology, tuberculous cystitis. This occurs when the ulcer is located at or near the trigone, bladder irritability resulting from its presence. The differentiation is easily made by cystoscopy, the simple ulcer appearing regular and decisive in outline, with a base of clean, reddish granulation tissue.

Granulomata

Tuberculosis of the urinary bladder, it may be assumed, is always a secondary process, the infection reaching that organ (1) by direct extension from neighboring foci; (2) along the lymphatic channels; (3) by the hematogenous route; or (4) by the means of urine. Of these avenues of transmission, descending infection along the ureter or in the urine is the most important and most frequent. Indeed, vesical irritability may be the first symptom of renal tuberculosis.

The disease is chronic in its course, and is most commonly found in early adult life, between the ages of twenty and forty years. The earliest symptom is increased frequency of urination. Perhaps the presence of red blood-cells in microscopic quantities in the urine does precede bladder irritability, but this symptom is not readily discovered. Or, gross hematuria may be the first evidence of the disease, the blood not being thoroughly mixed with the urine as in hemorrhages from the kidney. In the course of vesical tuberculosis a cystitis is produced, pain during and at the end of urination, referred along the urethra or localized at the neck of the bladder, being added to the early pollakiuria.

The urine contains mucus, pus, red blood-cells, and epithelium, and is alkaline in reaction in the late stages. Pyuria with acid urine is very suggestive of tuberculous disease. Late in the course, chills and fever, anemia, loss of weight and strength occur, while pain becomes constant and almost unbearable. The finding of tubercle bacilli in the catheterized specimen of urine, and the reproduction of typical tuberculous lesions after guinea-pig inoculation, while proof positive of tuberculosis, do not localize the process. Hence, cystoscopy is the most valuable means of diagnosis.

This disease should always be considered when symptoms of cystitis, pyuria or hematuria are encountered. If a focus can be determined elsewhere in the genito-urinary tract—a nodular epididymis, an enlarged irregular prostate or an enlarged, tender kidney—or in the lungs or peritoneum, a presumptive diagnosis can be made. When a cystitis fails to respond to proper treatment, tuberculosis is frequently the etiologic factor. A tuberculous infection may be superimposed upon a gonorrheal cystitis, and usually aggravates the symptoms.

Syphilis of the bladder wall occurs in the form of mucous patches, ulcerations, and gummata, with subsequent ulcer formation. The clinical course, as well as the cystoscopic appearance, may simulate tuberculous cystitis. The absence of

other tuberculous foci, the history and the positive Wassermann test, and the reaction to treatment are the important guides to diagnosis in such cases.

Inflammatory Conditions

Cystitis.—Inflammation of the bladder or cystitis occurs in both the *acute* and *chronic* forms. An etiologic factor is practically always demonstrable and, in fact, materially contributes to the diagnosis. Thus, cystitis may arise from (1) an ascending infection from the urethra, prostate gland and seminal vesicles; (2) descending infection from the kidneys and ureters; (3) by continuity, as from an appendical abscess, pyosalpinx and psoas abscess; and (4) by the blood stream. The disease is bacterial in nature, but may be excited by irritant drugs, such as the balsams, cantharides and the dye stuffs, or by highly acid urine as found in gouty patients. Also, foreign bodies, tumors, calculus and urinary obstruction are frequently responsible, while instrumentation is a fairly common cause. In women, a colon bacillus cystitis is often seen without antecedent disease.

The symptoms of *acute cystitis* are characteristic. The onset is sudden with some fever, and hypogastric or perineal pain which becomes constant or intermittent. There is urgent and increased frequency of urination with severe, burning pain during and after the act. Vesical and rectal tenesmus are often associated. Upon palpation over the hypogastrium, tenderness is elicited, and there may be a certain degree of protective muscle spasm; the urine is cloudy and contains pus, blood and bladder epithelium.

The diagnosis is usually obvious, but the type of cause can often best be shown by cystoscopy. The urine should be cultured.

Chronic cystitis follows the acute form or develops gradually, particularly when there is a foreign body or urinary obstruction caused by an enlarged prostate gland or urethral stricture. Pain is not constant. It varies from a sense of hypogastric or perineal discomfort to severe vesical tenesmus. Increased frequency of micturition, with or without pain, is the essential symptom. The urine is turbid, of foul odor, contains pus, blood and epithelium, and is usually alkaline in reaction. Anemia and a moderate constitutional reaction ensue.

Tumors

Tumors of the bladder manifest their presence by hematuria, symptoms of cystitis, or mechanical interference with the expulsion of urine from the bladder. Most tumors occur in late adult life, and affect the male far more often than the female. Sarcoma and myxoma (mucous polyp) occur in childhood especially; carcinoma after the age of forty-five; and the benign tumors in general about the age of thirty, or later. While benignancy is characterized by a slow rate of growth, some such tumors increase in size rather rapidly. Cystitis develops in all bladder tumors and pyelonephritis in prolonged cases, so that indirectly an histologically benign tumor may produce death.

TUMORS OF EPITHELIAL ORIGIN

Papilloma or villous tumor of the bladder is the most common new growth, and occurs most frequently in middle life. The intermittent occurrence of pain-

less bleeding is the most important symptom. Such attacks of hematuria vary greatly, both in severity and duration. The blood and urine are admixed, or, when hemorrhage is small in amount, bright red blood is passed at the end of urination. If clots are formed and difficulty experienced in passing them, there is pain. Otherwise, pain only occurs under two conditions; namely, when the tumor obstructs the internal urethral opening, or when cystitis develops, the latter very often being the result of instrumentation. The course is chronic and anemia is a late symptom. Most suggestive is a sudden stoppage of the urinary stream, as the villous tumor is pedunculated and may float over the vesical outlet. Malignant degeneration sometimes takes place in a papilloma.

Adenoma of the bladder is not common. It closely resembles carcinoma in its clinical picture.

Carcinoma, the most common malignant tumor of the bladder, occurs usually after forty-five, and is of slow or rapid growth. It may arise primarily or as a result of malignant degeneration of a papilloma. Like papilloma, the early symptoms are pain and hematuria. Severe cystitis and its complications characterize the advanced stage of the disease, and pain becomes excruciating in the neck of the bladder or perineum, and is often referred along the penis. Urinary obstruction sometimes is produced, or the patient requires catheterization because of spasm of the bladder sphincter.

The inguinal glands become hard and enlarged relatively late in the disease, while cachexia also is slow in development. The urine furnishes evidence of a most diffuse cystitis, and may contain bits of tumor tissue. It is supposed to occur quite frequently in anilin workers.

A rarity among bladder affections is **dermoid cyst**. Its symptoms are mechanical. The passage of oil globes in the urine is characteristic but very infrequent.

TUMORS OF CONNECTIVE TISSUE ORIGIN

Myxoma, fibroma and angioma are rare tumors of the bladder, and, as a rule, produce mechanical symptoms.

Hematuria in these conditions is unusual. Their courses are chronic.

Sarcoma occurs particularly in childhood. Its rate of growth is usually more rapid than that of carcinoma, but, as in the other tumors of connective tissue origin, symptoms of a mechanical nature predominate and usually antedate bleeding. Cachexia and cystitis soon appear, and death occurs from the complications of either the tumor or the secondary cystitis.

TUMORS OF MUSCLE ORIGIN

Myoma is an unusual bladder tumor, often pedunculated, and sometimes obstructs the urinary stream. Hematuria may or may not occur.

Diagnosis of Bladder Tumors.—The most satisfactory means of diagnosis is cystoscopy. The type of new growth can be inferred with reasonable accuracy by this procedure. The infiltration of malignant tumors can often be felt by rectum or vagina, or by bimanual palpation. Occasionally, fragments of tumor tissue are found in the urine. The symptoms cited (hematuria, mechanical interference and cystitis) suggest the presence of a new growth of the bladder, and require further investigation.

DIFFERENTIAL DIAGNOSIS OF BLADDER CONDITIONS

Disease	Age	Pain: Type and Radiation	Rigidity and Tenderness
Urinary retention	Children, pregnant women, old men.	Fullness, and, at times, acute, in bladder region.	Slight or marked over bladder region.
Acute cystitis	Any.	Acute, spasmodic before and during urination, but most severe at end; referred to glans penis, prostate, rectum and perineum.	In very acute cases, present over suprapubic region. There is tenderness over bladder.
Rupture of bladder	Any.	Usually severe in pelvis and hypogastric regions. Patient anxious to urinate, feeling that it will relieve pain.	Rigidity pronounced over suprapubic region and lower abdominal quadrant. Pressure over symphysis and whole pubic region usually elicits pronounced rigidity and tenderness.
Vesical calculus	Common in children, may occur at any age.	Acute, or a discomfort in suprapubic region, referred to penis, rectum or perineum, often radiating down thighs, often worse at end of urination; during urination may be severe pain as stone blocks urethral orifice.	Rigidity slight over suprapubic region; marked over same region if calculus blocks urethral orifice. Tenderness is slight over suprapubic region; quite pronounced if stone is blocking urethral orifice.
Strangulation of bladder hernia	Especially in infants, adults and old age.	Sharp and stabbing over groin and suprapubic region, at times radiating to the penis and testicles.	Marked over suprapubic region, often radiating to groins and entire lower abdomen.
Vesical tumors	Usually after 30.	Usually not present unless tumor is malignant.	Usually not present, unless process is far advanced or unless cystitis accompanies the condition.

CAUSING ACUTE PAIN IN SUPRAPUBIC REGION

Mass	Urine	Special Data	Disease
Immobile, semifluctuant, symmetrical mass in suprapubic region. Tumor disappears on catheterization.	Large amounts obtained on catheterization.	If atony, difficulty in starting stream, or complete inability to urinate are present.	Urinary retention
No.	Variable amount of pus and red blood-cells.	Frequent urination. May be complete or partial retention.	Acute cystitis
In extraperitoneal rupture, urine infiltrates perineum and external genitalia and anterior abdominal wall, causing edema and brawniness with, often, abscess formation.	Small amount at first passed, tinged with blood; microscopic blood present, if any urine obtainable.	Follows trauma and most especially when bladder is full. More common in males. If peritonitis develops, typical picture of that disease. Occasionally small amount of urine mixed with blood is at first voided. Catheterization gives no urine, or only small amount, with blood. Injection of fluid into bladder, return is only small amount, or none at all.	Rupture of bladder
Stone may be felt by rectal or vaginal examination and through dilated female urethra; metal sound may detect it.	Pus—red blood-cells, a frank hematuria mixed with urine, not common.	Increased frequency early symptom. Rectal tenesmus common. Polyuria more common in daytime on account of exertions. During act of urination there may be sudden interruptions in stream. Patient may assume an unnatural position in order to urinate.	Vesical calculus
Boggy swelling at any point in lower abdominal wall; but most commonly found just internal to internal abdominal ring. It may enlarge on coughing. Strangulation most commonly occurs in morning after urine has formed a good-sized mass. Pressure over mass incites desire to urinate.	Red and white cells found. May be occult blood.	Uncommon. Especially in men, and particularly in cases of urinary obstruction of some nature. Diagnosis can be made preoperatively by cystoscopic examination. Often mass becomes smaller after urination.	Strangulation of bladder hernia
By bimanual or rectal examination, infiltration of floor of bladder can usually be detected.	Blood, pus, and tumor cells.	Usually first symptom is hematuria. Cystoscope. Frequent urination. More frequent in men.	Vesical tumors

Neuroses

The neuroses of the bladder comprise several conditions dependent solely upon nervous causes without organic lesions of the bladder itself. Some originate from actual spinal cord disease, as tabes and myelitis, while others are reflex influences from the adjacent or more remote organs. These disturbances are affections of the motor or muscular function for the most part, although sensory symptoms may be associated, and include: (1) Spasm and paralysis of the detrusor muscle; (2) spasm and paralysis of the vesical sphincter; and (3) enuresis.

1. Spasm of the detrusor muscle, or cystospasm, occurs in neurotic individuals, sometimes during severe mental strain, and reflexly from the rectum and prostate gland. Increased frequency of urination during the day, the urine being normal and no demonstrable organic lesion of the bladder being present, is the characteristic symptom.

The detrusor muscle may be completely or partially paralyzed, these conditions being found in injuries, tumors and diseases—especially tabes—of the spinal cord; during some of the acute fevers, such as typhoid; and in old age as a physiologic disturbance. In complete paralysis the patient is totally unable to empty the bladder, while in paresis of the detrusor muscle, evacuation is difficult and incomplete. If the vesical sphincter remains intact, the result in complete paralysis is an overdistended bladder which appears as a tense or elastic midline tumor, flat on percussion, above the symphysis pubis.

2. Spasm of the vesical sphincter produces straining at urination (dysuria) and difficulty in starting the stream. Spasm during the act of urination diminishes the size of the stream, or often interrupts it, thus causing an apparent dribbling when the spasm ceases. The cause is usually a chronic posterior urethritis.

Inefficiency of the vesical sphincter, amounting to a paresis or total paralysis, arises from the same causes as the similar affection of the detrusor muscle, with which it may be combined. Dribbling of urine, perhaps only after moderate distention of the bladder, or total incontinence, results. A catheter or other urethral instrument fails to encounter resistance at the neck of the bladder.

3. Incontinence, or enuresis, is physiologic during infancy. After the age of two years it may occur without evident cause, particularly at night. Oftentimes the etiology is from reflex causes, such as bladder calculus or cystitis, proctitis or anal fissure, or phimosis, while diabetes may be the causative factor.

AFFECTIONS OF PROSTATE

Method of Examination.—Palpation through rectum (*a*) with metallic sound introduced simultaneously into urethra, (*b*) without sound.

(*a*) If possible have rectum well cleaned out. Knee-chest or dorsal decubitus. Lubricate index finger, the nail of which is well trimmed. Slowly introduce finger which glides over the bulb and membranous urethra (the latter may or may not be recognized); two lobes of prostate then mapped out. Introduce with other hand or have assistant simultaneously introduce sound into urethra which locates the prostatic urethra.

(*b*) Same method without using sound.

Urethroscope may throw some light on the condition of the internal sphincter and appearance of prostatic urethra.

Cystoscope will define contour of lobes.

Congestion

Congestion or *hyperemia* of the prostate gland follows sexual excitement and is often an incident in the presence of a periprostatic inflammation and cystitis. The gland is slightly swollen, fairly hard to the feel, and at times sensitive to the touch.

Inflammatory Conditions

Acute catarrhal inflammation, or acute catarrhal prostatitis, is an inflammatory condition of the prostate gland, acute in character, due to the accumulation of inflammatory products within the gland. The most frequent cause of this affection is gonorrhea, though it may follow any of the following; namely, the acute infectious diseases, especially scarlet and typhoid fevers, the use of unclean instruments in urethral dilatation, trauma of the perineum, masturbation or excessive coitus; prolonged ungratified sexual desire, cystitis, following a debauch with an excessive drinking of alcohol and superpurgation. Hemorrhoids should also be considered as a possible factor in bringing on the condition. In fact, the causes are so numerous, including as they do bicycling, horseback riding, ulcerated tumors of the bladder, that the entire gamut will not be considered here. The condition is quite commonly found and is usually characterized by a sense of uneasiness and weight in the perineum and rectum accompanied by frequent and at times painful urination. The severity of the symptoms depends upon the extent of the lesion; thus, if we have a much swollen prostate, urinary retention is almost a constant symptom.

If, on the other hand, the prostatic swelling is very moderate, urinary retention will not usually be a prominent factor. A low grade of fever may be present. Rectal examination elicits a tender and enlarged gland, usually hard in character, and more or less symmetrical. Defecation is usually painful.

Abscess or abscesses of the prostate gland give rise to the same train of symptoms enumerated above, with the exception that chills and high fever are usually present, with more severe pain in the rectum and perineum, especially following urination and defecation. The gland is often asymmetric, softer, and usually shows one or more scattered areas of fluctuation. The abscess may rupture spontaneously into urethra or rectum, giving rise to a sense of great relief. In advanced and neglected cases, a through and through ulceration may take place, with the appearance of feces in the urine, or vice versa. The *acute suppurative type* is but an intermediate stage between the acute catarrhal and abscess formation.

Chronic prostatitis is a condition commonly found as a sequel of an acute affection of the gland. Its etiology is about identical with that of the acute form, though the causative factor or factors are at times more abused, leading up to a condition of chronicity. A long-continued series of urethral or bladder irrigations is a most important cause.

Its symptoms are most variable and exhibit a long-drawn-out train of discomfitures which are most persistent. They are usually of a milder type than are those found in the acute form, but ranging as they do perhaps over a long period of

time, become a menace to the patient both from a physical and psychologic standpoint. The sexual symptoms, including frequent, painful and imperfect erections, premature and nocturnal ejaculations, complete or partial impotence with or without sexual desire, sexual hypersensitiveness and precocious ejaculations, are, as is evident, varied and of a most annoying character.

The pain in this condition may vary from slight intercurrent spasms to the most severe intermittent attacks of pain referred over the whole genito-urinary tract. Backache, especially in the morning, burning, and at times severe pain in the rectum are of frequent occurrence. Dull pain referred to the glans penis is noteworthy. Prostatorrhea is often an accompanying symptom. Urination is slow and often of a dribbling character, depending upon the extent of the lesion. Hematuria in an advanced case may occur.

Rectal examination shows an irregular gland, hard or soft in character and sensitive to the touch. The urine often contains pus and prostatic discharge.

Prostatorrhea

This affection is characterized by a frequent discharge of prostatic secretion. It is often an accompanying symptom of chronic prostatitis, and may follow an acute or chronic attack of gonorrhea, especially the latter. Masturbation, ungratified sexual desire, and injection into the urethra and bladder of irritating substances are given as causes. The introduction of instruments may bring on the condition. Loss of sexual power and at times sexual perversion may be results of this condition.

Calculi

Their presence may occur without giving rise to symptoms, especially as is seen in the prostate of old men, and when the process is multiple and the size of the calculi minute. The symptoms usually simulate those of a chronic prostatitis, either mild or severe, generally the former; frequency and hesitancy in urination may be the first signs of an existing stone. The pain may or may not be associated with urination or defecation. The diagnosis is simple, provided the examiner can palpate a stone through the rectum or can detect it by metal sound, cystoscope or urethroscope. If a fistula is present, a probe passed into the gland may be of value.

Tuberculosis

Primary tuberculosis of the prostate gland is extremely rare, and is usually secondary to tuberculosis elsewhere, especially of the genito-urinary tract. It is essentially a disease of the young adult. The premonitory signs are painful and frequent urination accompanied by indefinite pains in the posterior urethral region, painful defecation and a sense of heaviness in the perineum. As the disease advances (usually chronic), a few drops of blood may be passed in the last few drops of urine, the symptoms become more aggravated, and pus and blood together with tubercle bacilli are found in the urine.

The gland is found to be markedly enlarged, symmetrical and nodular, fairly hard, with scattered areas of softening, perhaps fluctuation, and fairly tender to the touch. At times the abscesses break down and are discharged in the feces or urine. Cystoscopic examination may reveal the condition.

Hypertrophy

This is a frequent condition occurring in advancing years, especially between the ages of fifty to seventy-five. Many causes are ascribed to the disease, the most important of which are: Chronic gonorrhea, chronic prostatitis, diabetes mellitus, chronic alcoholism, arteriosclerosis and excessive venery over a long space of time. It should be borne in mind, however, that at times no causative factor may be given other than "old age."

Histologically, various types of prostatic hypertrophies present, but the differentiation of the clinical findings is so similar that we shall not here consider the histologic differences.

The symptoms as presented by the patient are dependent upon the extent and distribution of the enlargement. Some hypertrophies (and these are found in the majority of men in advanced years) give rise to few or no symptoms, while others cause such a severe train of symptoms with their associated complications that death often results.

The classical symptoms occurring with this class of patients are: frequency and difficulty in urination, accentuated at night and in the early morning; morning erections; incomplete or complete urinary retention and at times bladder distention with incontinence; a sense of almost constant suprapubic uneasiness, with little or no sense of satisfaction following urination, is often a most annoying symptom. The residual urine, which is practically a constant factor, in this class, together with instrumentation which may be necessary, usually gives rise to various grades of cystitis which in turn will aggravate the symptoms.

There is often rectal tenesmus, and sense of weight and dull pain in the perineum. The urinary stream is often small and feeble, and in a large percentage of cases there is a dribbling at the end of urination. If the middle lobe of the prostate gland is the site of greatest enlargement, the symptoms are usually of a more acute nature, and there is often a sudden shutting off of the stream while the patient is urinating.

In this particular type of case, acute urinary retention is common. Following frequent catheterizations, bleeding may occur. Rectal examination generally shows a large, fairly boggy gland, fairly regular in contour, either symmetrical or asymmetrical, depending upon the lobes involved; tenderness may or may not be present. The urine usually shows a low specific gravity, and the appearance of pus cells is almost constant.

Cystoscopic examination may reveal the condition.

Tumors

BENIGN

Fibromata are occasionally found as isolated tumors usually embedded in the gland; they are rarely detected on rectal palpation. These tumors may obstruct the canal, but are not diagnosed clinically.

Myofibromata should not be clinically differentiated from the benign hypertrophies.

MALIGNANT

Sarcoma is a very uncommon disease of the prostate. It occurs especially in childhood and early adult life, though infants and old men are not exempt. Its early manifestations are those of intermittent hematuria, especially during and at the end of urination; of pain and difficulty in urination, and finally of complete urinary retention with its accompanying symptoms.

The disease is rapid, and is often accompanied with severe pains in the rectum, radiating down the thighs and into the perineum. The gland is usually irregular and nodular, of large size, and soft and vascular in infants and young children. Older people present harder tumors. Abdominal symptoms from metastasis and inguinal gland enlargement may present in the course of the disease.

Carcinoma.—This is not an uncommon primary tumor of the prostate gland. The disease often presents symptoms referable to regions other than about the prostate, and at times it is only by rectal examination that carcinoma of this gland is detected. The condition may be primarily referable to the prostate, and an early diagnosis is often obtained.

The disease is commonly found in elderly men, and is often first recognized on account of difficulty and pain on urination, accompanied by a more or less bloody tinging of the urine. As the disease progresses, the amount of blood usually becomes more pronounced, symptoms of cystitis develop, and the pain, at times severe, shows signs of radiating down the thighs and along the course of the sciatic nerve. The inguinal glands become enlarged, and metastasis may be pronounced; intermittent attacks of bleeding are common; emaciation often follows.

Defecation becomes extremely painful, and complete urinary retention may follow a long-drawn-out course of urinary derangement. The amount of bleeding may be so profuse as to be a causative factor in the anemia which is so often present. Rectal examination usually elicits a hard, small, irregular prostate gland, usually but slightly sensitive to the touch. At times the gland may be soft and nodular, showing evidences of capsular invasion. The bony metastasis which is so frequently found in carcinoma of the prostate gland is known as von Recklinghausen's "ossifying carcinosis."

AFFECTIONS OF SEMINAL VESICLES

Inflammatory Conditions

Acute vesiculitis is usually of gonorrheal origin; less often it is pyogenic in nature. It is seen mostly in young adults, in whom it may be indicated by pain or discomfort referred to the rectum or perineum and aggravated by urination and defecation, particularly the latter. There are also increased frequency of urination and persistent erections. Ejaculation is painful, and blood and pus are usually found in the seminal fluid. Continuance of the inflammation sometimes results in abscess formation. Upon rectal examination the vesicles are felt to be swollen, and are very tender.

Chronic Vesiculitis.—Patients with chronic vesiculitis complain of urinary or sexual symptoms, or both. Increased frequency of urination is a common complaint.

Others have sexual weakness or impotence, preceded by excessive sexual desire and indulgence. Nocturnal emissions are frequent, the discharge often containing pus and streaks of blood. The source of a chronic urethral discharge may be in a chronically inflamed seminal vesicle. Rectal examination discloses enlarged, somewhat tender and thickened vesicle or vesicles, and digital massage followed by urination may bring forth a purulent or slightly bloody urethral exudate.

Tuberculosis

Tuberculosis of the seminal vesicles is probably always secondary to a disease of the prostate gland or epididymis. The appearance of pollakiuria and frequent emissions or other sexual symptoms will lead to the suspicion of vesical tuberculosis. Extraordinary sexual desire and power is suggestive in the early stages, while

RECTAL EXAMINATION

	Description
Bladder calculus	Usually negative. At times rectal examination elicits hard mass, sometimes movable, especially if bladder is empty. May be a bogginess about stone
Seminal vesical calculus ..	Occasionally palpated
Foreign bodies in bladder.	If bladder is empty a fairly large body may be palpated
Prostatic calculus	Often felt through rectal wall as a hard, stone-like mass
Peri- or intra-cystic induration	There may be a definite hardness and some irregularity about the prostate, tender to touch, and perhaps in some area giving a sense of induration
Acute prostatitis	An enlarged, swollen, more or less symmetrical gland, tender to the touch and usually hard in character
Chronic prostatitis	An irregular, hard or soft gland, tender to the touch. On massage of the gland prostatic secretion may be expelled
Abscess of prostate	Usually an asymmetrical enlargement, rather soft in consistency and showing, at times, one or more scattered areas of fluctuation; extreme tenderness is usual
Periprostatic abscess	Same as above with the exception that the mass is outside of gland and usually shows induration about gland
Tuberculosis	Usually an enlarged, asymmetrical, nodular, fairly hard gland, with scattered areas of softening, perhaps fluctuation. Tender
Hypertrophy of prostate..	Large, regular, boggy gland: usually no tenderness; symmetry depends upon lobes enlarged.
Benign tumors of prostate	Rarely detected by rectum
Sarcoma of prostate	Large, fairly boggy gland, usually regular: harder and more nodular in adults. May be tender.
Carcinoma of prostate ...	Usually stony hard, nodular and irregular gland with often a marked periprostatic induration. May be soft. Usually not tender unless degeneration is taking place, and examining finger may be covered with blood after examination. The gland may be unusually small. Rectal shelf may be noted

impairment and even impotence are late results. Involvement of surrounding structures with fistula formation in the rectum, perineum or bladder are possible, but infrequent sequelæ. Upon rectal examination, a tuberculous vesicle feels swollen and irregular, the firm and somewhat tender nodules being scattered among the normal or moderately thickened tissue.

Calculi

Calculus of the vesicle is not a common affection. It may exist without symptoms. Some patients experience pain at the time of ejaculation. If infection occurs, the symptoms are those of acute or chronic vesiculitis. A vesical calculus may, at times, be felt by rectal examination as a firm nodule within the vesicle, above and to the side of the prostate gland.

PAIN IN RELATION TO AFFECTIONS OF BLADDER, PROSTATE AND SEMINAL VESICLES

	Character	Relation to Urination	Relation to Defecation	Radiation from Suprapubic Region
<i>Bladder</i>				
Distention	Sharp or dull	Relieved by	None	Heaviness in suprapubic region
Calculus	Sharp	Increased	Associated tenesmus	Radiates to rectum, perineum, penis
Foreign bodies	Sharp or dull	Often increased	None	Often radiates to perineum and penis
Hernia	Dull or sharp	Relieved by	None	None
Inflammation	Sharp—dull	Before, during, after	Associated tenesmus	Perineum, rectum, penis, thighs
Neuroses	Variable	Throughout	None	Usually, none
Rupture	Sharp—dull	Usually absent	None	Pelvis, abdomen, perineum, genitalia
Tuberculosis	Dull—sharp	Increased	None	Perineum, penis
Benign tumors	Usually absent	None, unless temporary obstruction	None	None
Malignant tumors	Sharp—dull	Often relieved	Associated tenesmus	Rectum, perineum and thighs
<i>Prostate</i>				
Acute prostatitis	Sharp	Before—during	Associated tenesmus Increased on defecation	Uneasiness and weight in perineum and rectum, acute pain in rectum and perineum
Chronic prostatitis	Intermittent Dull Sharp	Increased during and after	Associated tenesmus Increased on defecation	From slight intercurrent perineal spasms to the most severe intermittent attacks of pain referred over whole genito-urinary tract Morning backache, often extreme rectal pain Dull pain—glans, penis, thighs

PAIN IN RELATION TO AFFECTIONS OF BLADDER, PROSTATE AND SEMINAL VESICLES (*Continued*)

	Character	Relation to Urination	Relation to Defecation	Radiation from Suprapubic Regions
<i>Prostate (cont.)</i> Abscess	Sharp	Before, during, after	Associated tenesmus Increased on defecation	Rectum, perineum, thighs, back
Periprostatic abscess	Sharp	Before, during, after	Same as above	Same as above
Calculi	Dull Sharp	May or may not be associated with	May or may not be increased	Often testicular pain referred to penis and neck of bladder. Dull pain in perineum
Tuberculosis	Sharp Dull	Before—during	Increased	Dull pains in posterior urethral region, rectum, perineum. Often becomes of sharp type
Hypertrophy	Dull Sharp	Before—during	May or may not be associated	Often referred to thigh, perineum, testicle, penis and rectum
Sarcoma	Sharp Dull	During—after	In advanced stages, increased	In rectum, radiating to perineum and thighs and often along course of sciatic nerve
Carcinoma	Dull Sharp	Before, during, after	Often increased	Same as sarcoma
<i>Seminal Vesicles</i> Acute vesiculitis	Sharp	None	None	Along urethra to perineum, rectum, penis
Chronic vesiculitis	Intermittent Sharp	None	None	Same as above
Calculus	Intermittent Sharp	None	None	Same
Tuberculosis	Dull—sharp	None	None	Same

DIFFERENTIAL DIAGNOSIS OF CONDITIONS CAUSING CHRONIC PAIN IN SUPRAPUBIC REGION

Symptom	Cystitis, Chronic	Calculus, Vesical	Prostatic Hypertrophy	Carcinoma, Prostate	Carcinoma, Vesical
Age	Mostly adult and advanced.	Any. Often in children.	Advanced age.	After middle age.	Middle and advanced.
Pain	In pubic region. Moderate or severe; worse upon urination. Tenesmus frequent.	Similar to that of cystitis. May be severe, and referred to genitalia.	Suprapubic and perineal. Especially, prior to urination.	Suprapubic, perineal, sciatic distribution. Moderate or severe. Worse before and during urination.	Suprapubic, mild or severe. Worse upon urination. May be constant, burning, associated with tenesmus.
Tenderness	Common above pubes in midline; sometimes on rectal palpation.	Suprapubic region and upon rectal palpation; or absent.	If bladder is distended. Also, upon rectal palpation.	If bladder is distended. Usually present upon rectal palpation.	Suprapubic, over bladder.
Rigidity	Unusual.	Unusual.	Unusual.	None, unless complications.	Absent or moderate, over pubis.
Mass	In some, distended bladder—rounded or ovoid; tense or elastic; dulness; in median line. Size variable.	If large, and attached to fundus of bladder. Or felt by rectum. Distended bladder, if obstructing outlet.	Distended bladder common. Enlarged, smooth, firm prostate felt through rectum.	Distended bladder frequent. Large or small prostate; hard, often irregular and fixed.	Infrequently palpated. May be felt per rectum.
Blood	Negative.	Negative.	Negative.	Secondary anemia.	Secondary anemia.
Stools	Negative.	Negative.	Negative.	Negative. May be constipation.	Negative.
Urine	Mucus, bladder epithelium, fibrin and pus cells.	Blood-cells, or same as cystitis.	Same as cystitis. Albumin, casts.	Usually signs of nephritis, cystitis, hematuria.	Gross blood, at times. Signs of cystitis.
Special data	Symptomatic in most cases. Search to be made of etiologic factor, in urethra, prostate, bladder, ureter and kidney, using x-ray and cystoscopy. Mass disappears upon catheterization.	Straining or painful urination. Sudden interruption of stream. Associated phimosis in children. (Cystoscopy. Metal sounds. X-ray.	First symptoms noted upon urination. Secondary symptoms, those of kidney impairment.	Difficulty in starting urination. Interruption of stream. Secondary kidney inefficiency. Loss of weight and strength. Increasing pain and difficulty. Catheterization. (Cystoscopy.	Urinary symptoms—pain frequency, interference with stream, bladder distention, gross hematuria. Loss of weight, strength and appetite. Cystoscopy.

Symptom	Dysmennorrhea	Uterine Malposition	Ovarian Cyst	Chronic Intestinal Obstruction	Chronic Pelvic Peritonitis
Age	Puberty to menopause.	Puberty to advanced age.	Any.	Any.	From puberty onward.
Pain	At menstrual periods—before or during. Cramp-like.	Suprapubic pain in the presence of complications, especially cystitis. Common during menstrual periods.	Usually none. May be slight pain from adherence, or severe pain from inflammation or pressure on intestines. Pain local or diffuse.	Cramplike, colicky, localized in suprapubic region, or diffuse with local exaggerations. Intermittent. Recurrent.	In suprapubic region, and one or both lower quadrants. Worse at menstrual periods.
Tenderness ...	Suprapubic, over fundus of uterus. Sometimes upon pelvic palpation.	In complications and during menstruation.	Usually none.	Slight or absent at intervals. During acute exacerbations; either local or scattered points of tenderness.	Lower abdomen, over uterus and adnexa. Usually bilateral. More evident upon bimanual examination.
Rigidity	May be slight at menstrual periods.	Absent.	Absent.	Slight or absent. Increased during exacerbations.	Absent or moderate above pubes and to sides.
Mass	Not in ordinary case.	Uterine body and cervix in abnormal situations.	Rounded or oval; firm, tense or fluctuant; usually smooth; movable or fixed. Extends laterally from suprapubic region. Palpated to side of uterus upon vaginal examination.	May or may not be felt on abdominal or pelvic examination.	If abscess or pyosalpinx develops.
Blood	Negative.	Negative.	Negative.	Negative.	Negative.
Stools	Negative.	Negative.	Negative.	Constipation. Perhaps diarrhea, blood in stools	Negative.
Urine	Negative.	Negative, or as in cystitis and secondary nephritis.	Negative.	Negative.	Negative.
Special data ..	Malposition of uterus, atresia of cervix or vagina, infantile uterus, and local pelvic inflammatory disease are causative factors.	Congenital, developmental, acquired, or operative malposition. Pelvic tumor, cystocele, rectocele or other associated conditions.	Often exists without any symptoms. Gradual abdominal enlargement significant. Cyst subject to infection, torsion and adherence. Sometimes exerts pressure on bladder, pelvic vessels or intestines.	Periodic attacks of partial obstruction—vomiting and constipation, distention. Radiography. History of pelvic peritonitis, inflammatory attacks, former operations. Perhaps visible peristalsis.	History of vaginal discharge and acute attacks. Uterine fixity and pelvic thickening. Signs usually bilateral.

AFFECTIONS OF THE PENIS AND THE URETHRA

Penis	congenital anomalies	{	congenital absence
			rudimentary penis
			hypospadias
			epispadias
			double penis
			congenital and acquired phimosis
	injuries	{	congenital stricture of urethra
			contusion
			hematoma
			wounds
			rupture of frenum
			rupture of urethra
			fracture
			dislocation
			strangulation
			gangrene
	paraphimosis		
	hypertrophy		
	megalopenis		
	inflammatory conditions	{	balanitis
			posthitis
			cavernitis
			cellulitis
			abscess
			poison ivy
			chancroid
	phagedena		
fibrous sclerosis			
calculi			
osseous transformation			
curvature			
elephantiasis			
affections of skin	{	herpes	
		molluscum contagiosum	
		dermatitis	
		keratosis	
granulomata	{	syphilis	chancere
			ulcerated papule
			mucous patch
			gumma
		actinomycosis (rare)	
			tuberculosis (rare)

Penis (<i>cont.</i>)	tumors	benign	- papilloma or wart - horns - chondroma - condyloma (if not venereal) - sebaceous cyst - dermoid cyst - lipoma - neuroma - fibroma - adenoma - nevus
		malignant	- carcinoma - sarcoma (rare) - intravascular endothelioma (rare)
Urethra	injuries	- contusions - rupture	
	inflammatory conditions	- acute - periurethral abscess - subacute - chronic	
		non-specific	- ingestion of foods and drugs - irritating injections - diabetes and rheumatic diathesis - sexual excess
		specific	- gonorrhea - syphilis - typhoid - pneumonia - diphtheria - the pyogenes
	stricture	- congenital - acquired	- inflammatory - spasmodic
		organic	- inflammatory - traumatic - urethral chancre - gonorrhea - neoplasm
	calculi		
	foreign bodies		
	granulomata	- syphilis (urethral chancre) - tuberculosis	- primary (rare) - secondary
	fistula	- urethropenile - urethroperineal	- urethroperineoscrotal - urethrorectal - urethroperineorectal
	tumors	- benign - malignant	- papilloma - carcinoma
			- polypi - multiple papillomata - caruncle - primary - secondary

History

Age

Family History.—Tuberculosis, syphilis, cancer or other tumors. Urethral anomalies.

Personal History.—Acute infectious diseases, complete venereal and alcoholic history, tuberculosis, previous instrumentation, old injury or persistent “gleet.” Difficulty in exposing glans. Previous discharge from, or about, prepuce or from urethra or from both.

Present Illness.—Date and onset and relation, if any, between present condition and gonorrhea, syphilis, coitus, debauches, injury, recent instrumentation, “gleet,” exposure to poison ivy, irrigations, ingestion of special foods and drugs, acute infectious diseases. Pain: if present, character and radiation. Recent tuberculosis or operative procedures. Burning on urination and location. Hematuria.

Physical Examination.—Describe accurately and in detail the *presenting lesion*: This should include location, single or multiple, contour and consistency, movable or fixed, condition of the skin overlying the lesion, pain on pressure and description of ulceration, if present. Description of meatus, if abnormally situated or abnormally formed. Signs of injury or evidence of recent strangulation of prepuce or of penis, presence of edema or inflammation about prepuce. Urethral discharge (immediately visible or only after the milking of the posterior urethra). Enlarged regional lymph glands (tender or painless on pressure). Wassermann. Reaction to antisyphilitic medication. Tuberculin tests. Urethral divulsion. Examination with urethroscope, and possibly with sound. Occasionally, radiographs are helpful (if urethral calculus is suspected). Complete examination of the urine, including presence of shreds and red and white blood-cells. Bacteriologic examination of urethral discharge or smear from urethral or penile sore. Microscopic examination of tissue removed. Signs of syphilis or other organic lesion elsewhere.

INTERPRETATION OF HISTORY

Age.—Though the congenital anomalies must be considered as affections of birth and early childhood it must be remembered that the condition may not present to the physician or surgeon until the patient has reached adolescence or adult life. Phimosis, which is so commonly found in infancy, may give rise to few or no symptoms for many years and its presence may be entirely forgotten until surgery is demanded on account of a balanitis, or complete closure of the meatus. Tuberculosis of the penis though extremely rare has been noted in the infant circumcised by the Jewish method. Nevus of the penis is essentially a lesion of the newborn. Dermatitis of the penis is occasionally observed in the young infant who usually presents some organic lesion elsewhere in the body. Partial or complete strangulation or gangrene of the penis is at times noted in the young child as well as in the adult; in the former, due to the application of threads or rubber bands about the root of the penis by some child perhaps a little older, who unconsciously looks upon the deed as one of a real prank; in the latter, by the insertion of a band or ring of metal or what not, this performance taking place usually during a debauch. The inflammatory and venereal con-

ditions of both penis and urethra most frequently occur during the period of young adult and adult life, but it must be borne in mind that even the young child and the old man are not excluded from this class of cases. The urethral stricture so commonly found in the adult and usually caused by venereal disease is, on the other hand, extremely frequently noted in the aged, due, not as a rule to a urethral stricture *per se* but to pressure from without. Calculus of the urethra is most often found in the adult though at times, and due to a persistent phimosis, it may be met with in the young child. Calculus of the penis is essentially a condition of old age. The benign tumors of the penis are found at any time after the period of adolescence but are more frequently met with in the adult and the aged. Carcinoma is, of course, essentially a disease occurring after the age of forty-five, though younger men have been afflicted with the condition.

Family History.—A surprisingly large number of individuals presenting congenital anomalies of the urethra give the family history of such conditions. The family history of tuberculosis, cancer and other tumors should be reckoned with, more from the standpoint of interest than from true diagnostic significance. Congenital syphilis may be an important factor.

Personal History.—Cavernitis, cellulitis, abscess and phagedena of the penis together with acute urethritis may be complications of the *acute infectious diseases*. The importance of a *complete venereal and alcoholic history* is beyond question, the vast majority of the affections of both penis and urethra being due primarily to infection by the spirochete or gonococcus. A tuberculous urethritis though extremely rare may follow in the course of a generalized or genito-urinary *tuberculosis*. Acute, subacute and chronic urethritis frequently follow *instrumentation*, which history in itself may give a clue to a previously existing urethral stricture. *Persistent gleet* is a recognized cause for a subsequent urethral stricture. *Difficulty in exposing the glans* is often the presenting symptom of a congenital or acquired phimosis, while the same symptom may be the forerunner of any of the inflammatory conditions of the penis or perhaps the urethra.

Present Illness.—*Relation between Present Condition and Gonorrhea.*—This is of great importance in as much as so many of the lesions of both penis and urethra are secondary to this infection; namely, balanitis, posthitis, cavernitis, cellulitis, abscess, phagedena, the inflammatory conditions of the urethra and urethral stricture. It must also be remembered that the history of gonorrhea always indicates the possibility of an intra-urethral chancre.

Relation to syphilis brings forth the probability of chancre of the penis, intra-urethral chancre, posthitis, ulcerated papule, mucous patches of the penis and gumma.

Relation to coitus gives an indication as to whether the patient was subjected to the possibility of the various venereal infections, and to the various injuries and inflammatory conditions of both the penis and the urethra.

Relation to injury causes one to think of the possibility of rupture of the urethra or penis, hematoma, fracture or dislocation of the penis, perhaps the various inflammatory conditions of the penis and strangulation and gangrene.

Recent instrumentation is often followed by acute and subacute urethritis, as is also rupture of the posterior urethra.

Exposure to poison ivy is often significant when one presents an eruption on the penis of puzzling origin.

Irrigations and ingestion of certain foodstuffs and drugs often cause the various types of non-specific urethritis.

Acute infectious diseases are often complicated by cavernitis, cellulitis, abscess and phagedena, together with acute urethritis.

AFFECTIONS OF THE PENIS

Congenital Anomalies

Rudimentary penis is a condition in which the penis is buried in the scrotum or beneath the skin of the pubis.

Hypospadia is a congenital and often hereditary condition in which there has been a failure of union of the halves of the urethra, leaving an open midline furrow on the ventral surface of the penis. The abnormal opening of the urethra is always anterior to the triangular ligament, appearing at any point but usually just behind the attachment of the frenum to the glands, urine escaping through the opening. The bladder and sexual functions are usually normal. The penis is often small and is frequently deformed and bound down to the scrotum, particularly in complete hypospadia, where the urethral meatus is behind the scrotum in the perineum. In this type of case the scrotum is divided into two parts and the testicles are often undescended and sexual functions are absent. Often there is a depression in the glans at the site of the meatus.

Epispadia is a congenital affection of the urethra in which either a portion or the entire dorsum of the urethra is undeveloped. Four types are recognized, namely: (1) The defect is limited to the glandular portion. (2) The defect involves the penile portion. (3) There is an involvement of the glandular and a portion of the spongy urethra. (4) There is an involvement of the entire anterior urethral canal. The severity of the symptoms is in direct proportion to the magnitude of the canal involvement. Thus, in the glandular type, coitus is but slightly interfered with and the bladder functions are in no way disturbed, while in cases of the advanced type incontinence of urine with difficulty in coitus are the main signs.

Congenital phimosis exists when the orifice of the prepuce is too small to allow the glans to be uncovered. This condition occurs in newborn infants but may not appear until past middle age (acquired phimosis). Congenital phimosis appears in various degrees, from simple inability to retract the foreskin, to obstruction of urination. *Acquired phimosis* is usually due to a chronic irritation of the prepuce caused by an inflammatory condition of the foreskin which has lasted over a long period of time. The symptoms are those of the congenital type.

Injuries

Fracture.—A rupture of the corpora cavernosa occurs during erection, from a violent movement during coitus or by blows or falls; the urethra may be ruptured at the same time. "Fracture" is usually a more or less deep horizontal tear in the corpus cavernosum at any point, often with the formation of a large hematoma.

Marked swelling and ecchymosis are a usual accompaniment of this condition. The escape of blood from the meatus, if the urethra is torn, and extravasation of urine appear; pain and tenderness of the penis and the soft tissues in the groin are present. The late results are infection, nodular cicatrization with angulation and at times an hypertrophy of the penis. Palpation of the penis before swelling occurs shows irregularity in the contour of the corpus. Rupture of frenum and urethra, at times, occurs.

Dislocation of penis is a condition due to trauma. The prepuce and frenum are torn at or near the junction with the glans, allowing the body of the penis to retract and become buried under the skin of the scrotum or behind the pubis. Marked swelling and infiltration occur if the patient attempts to void. Rupture of the urethra may accompany this condition.

Strangulation is a condition brought about by the encircling of the shaft of the penis, usually near the root, by some constricting object, such as an elastic band, thread or metallic ring. If the constricting object entirely shuts off the circulation, gangrene follows.

Gangrene of penis follows trauma, inflammatory processes, burns, urinary infiltrations and infections. An acute progressive gangrene may occur in diabetes, typhus fever and cantharides poisoning. It is frequently due to constricting bands. The penis quickly becomes markedly edematous, cold, glistening and tense; followed by definite gangrene with its accompanying loss of sensation, change in color, actual death and sloughing of tissue (if not relieved). It is usually of the moist variety. At times a line of demarcation develops.

Paraphimosis exists when the prepuce is forced behind the corona glandis and cannot be replaced. It occurs in balanitis, herpes, chancroid, chancre and gonorrhea, and occasionally occurs after forceful stripping back of the foreskin. The prepuce forms a constricting band behind the glans, the latter being swollen, livid, and painful. If continued, the prepuce and the glans become inflamed and edematous. The constriction appears like a cartilaginous ring, and the glans may become gangrenous. The glans is tremendously swollen; behind the corona, the mucous layer of the foreskin presents as a prominent red or blue shining edematous collar. The swollen skin forms another and posterior ridge, the constriction lying in a deep sulcus between the two.

Hypertrophy

Hypertrophy of the penis is a rare condition but may exist in either a local or general form. The cause is usually a chronic inflammation of the glans of the penis or of the inguinal region; in the local form, the parts most often affected are the prepuce and the neighboring skin; the latter is markedly thickened and no pain is present. The generalized form follows the local variety and may cause an inflammation of the lymphatic glands of the penis with an accompanying suppuration of the inguinal chain.

Inflammatory Conditions

Balanitis is an inflammation of the surface of the glans penis, often associated with posthitis. It consists of a bright redness and moisture of the surface, with the presence of a creamy secretion of an offensive odor, and is accompanied by constant

itching or burning. A circinate form, appearing as concentric patches resembling ringworm, at times is seen. Balanitis occurs in phimosis or long foreskin and gonorrheal or other forms of urethritis and chancroid.

Posthitis is an inflammation of the prepuce, generally of its mucous lining, occurring in the course of gonorrhea, chancre or chancroid, and those suffering with phimosis or long foreskins. It is common in old men. The prepuce is reddened, swollen and moist, with a creamy, offensive discharge, and accompanied by itching and burning. The surface is often excoriated in irregular patches, or superficial ulcerations are formed. Chronic balanoposthitis occurs in men past middle age. There is a mild inflammation, associated with thickening of the prepuce, the surface of which appears granular or superficially ulcerated. It often causes phimosis. There is scalding pain on urination. The skin of the prepuce and glans becomes thick, granular and raw in places, and white and thickened in others. Warts and adhesions result from irritation.

Cavernitis is a suppurative inflammation of the corpora cavernosa, appearing usually as a deep, localized, palpable infiltration which goes on to abscess formation. In other cases there is a diffuse process accompanied by septic symptoms. There is marked priapism, followed by sloughing or gangrene, and causing later, deformity. Pyemia is frequent. *Chronic cavernitis* is a very rare condition of fibrous sclerosis, presenting single or multiple, small, hard discrete lumps in the sheath of the corpus cavernosum. Erection is defective. The penis curves in one or the other direction and circulation is more or less impeded.

Cellulitis follows injury, wounds, urinary infiltration, gonorrhea and chancroid. There is marked redness and swelling of the penis, accompanied by pain, and often ending in extensive necrosis or gangrene. General symptoms of sepsis are present.

Abscess is caused by local infection, or as a complication of cellulitis. The onset is characterized by localized swelling, redness and pain. The region at first is hard and brawny, and later becomes fluctuant and suppurates. There is a constitutional reaction.

Ivy poisoning is usually secondary. There is a history of exposure. There are lesions on the hands, face or other parts of the body. The onset occurs within a few hours after contact. It consists of erythematous patches, with vesicle formation: later rupture, causing abundant serous weeping. There is swelling and edema, and intense itching and burning.

Chancroid (*soft chancre*), caused by *B. Dugrey*, is a rounded or oval ulcer, appearing within ten days, usually two or three days, after exposure. It is either large or small, usually *multiple*, simple or composed of several ulcers which fuse. The edges are abrupt, sharply at right angles to the surface, are very often undermined, and are surrounded by a faint pink areola. The floor of the ulcer is pallid, with pink granulations, bathed in thick pus, or pultaceous and yellow material, appearing like dirty cream. This surface is adherent. The base of the ulcer can be lifted up from the underlying tissues, and presents no marked rigidity. It tends to spread rapidly, with destruction of tissue. The inguinal glands enlarge; periglandular swelling; tissues boggy; skin adherent; often suppuration occurs. The duration of chancroid is from four to six weeks. Ecthymatous chancroid presents a scabbed surface, from beneath which pus oozes, and surrounding which is a livid areola. Follicular chancroid appears first as a large, acuminate pustule, which breaks

down and presents as a typical ulcer. The base of an irritated chancroid becomes indurated and elevated. Chancroid sometimes becomes phagedenic. Others assume a serpiginous character. An unirritated chancroid is not painful, except upon handling and erection.

Phagedena is a destructive form of ulceration arising upon a chancre or chancroid, in debilitated subjects. Anemia, alcoholism, diabetes, and Bright's disease are important predisposing causes. It is characterized by a rapid spread of ulceration on all sides of the lesion and also deeply into the tissues, or it may assume a serpiginous character, extending only at one edge. The ulcer is irregular in shape, with congested and edematous edges, and a foul, sloughing floor. A large portion of, or the entire penis may slough; the ulcer has no tendency to heal. The surrounding tissues become deeply congested, undermined, and undergo rapid necrosis.

Fibrous Sclerosis

Fibrous sclerosis of the penis is an affection of unknown etiology and is due to a formation of fibrous "blocks" in the corpora cavernosa or corpus spongiosum. The masses may be single or multiple, unilateral or bilateral, nodular and hard, fairly movable and usually situated near the dorsum of the penis. The affection progresses slowly but eventually leads to more or less distortion or deformity of the penis. During erection the organ tends to curve or bend and causes the patient marked discomfort. Pain is present when the penis becomes engorged and congested. It is essentially an affection of men between the ages of forty-five and sixty-five.

Calculi

Calculus in the penis is an infiltration of the tunica albuginea with calcareous deposits, found in old people. Preputial calculus consists of a hardened, calcareous deposition about or upon a chronically inflamed prepuce of years' duration, and is also more common in the old.

Osseous Transformation

Osseous transformation of the penis occurs extremely rarely and consists of the transformation of scattered masses of fibrous tissue into bone. The bony plaques are single or multiple and seldom larger than one half inch in diameter.

Curvature

Curvature of the penis is a rare condition and is usually accompanied with some congenital deformity of the corpus spongiosum.

Elephantiasis

Elephantiasis of the penis is a rare affection. The penis increases in size to huge proportions. The skin becomes hard, brawny, and warty. The surface is the seat of excoriations, and, between the folds of hardened epidermis, eczema, blebs, and ulcerations may occur, the latter discharging a milky, chylous fluid which sometimes contains filarial embryos. *Filaria bancrofti* are obtained from the blood at night.

Affections of the Skin

Herpes of the penis is characterized by clusters of transparent vesicles from two to twenty or more in number, situated on an erythematous base, and surrounded by a narrow red zone, particularly on the inner surface of the prepuce but also on the glans, sulcus and about the meatus. It begins as a reddened area which rapidly becomes vesicular. On the mucous membrane these are reduced to a whitish pulp, resembling a false membrane, which, if detached, reveals a number of roundish excoriations, either scattered, irregular or uniting to form large ulcers. These are accompanied by itching and burning. They later become desiccated, forming yellowish crusts which drop off, leaving a brownish stain which gradually fades. Inguinal adenitis frequently develops.

Mollusum contagiosum is infrequent. It begins by the formation of small growths likened to mother-of-pearl buttons. They are flattened at the top where there is a depression containing a visible aperture which leads into the interior of the tumor. A whitish material, or a milky fluid, can be squeezed out through this opening. A small mollusum may resemble a hard chancre but similar growths are found elsewhere. Microscopic examination of the fluid is of importance.

Dermatitis is an eczema, usually associated with eczema of the scrotum. It is marked by infiltration, fissures and excoriations, and accompanied by severe itching and burning. From a differential standpoint scabies are multiform lesions with burrows or cuniculi. Typical lesions are on fingers, wrists and axillary folds. Identification of the itch-mite. Acne appears as discrete papular lesions, capped by vesicles containing whitish thick sebaceous material. Other parts of the body are affected. The lesions of psoriasis are composed of discrete brownish red lesions or extensive papules, which may be elevated above the surrounding skin, and which are covered by fine, silvery-white, imbricated scales. These scales can be easily detached, without leaving a bleeding surface.

Keratosis is usually a disease of early life. The lesions consist of firm, pinhead to pea-sized, grayish or reddish papules, situated at the pilosebaceous orifices and partially covered by firmly adherent brownish or blackish, greasy, horny crusts. When these crusts are removed a minute, funnel-shaped depression is left on the top of the papule. The papules increase in size as they grow older, and become dark brownish or even purple. Lesions at first are discrete, but later become confluent and on the genitalia tend to become vegetative and involve, also, the interfollicular tissue. The scalp and face are first attacked, but the lesions are more prominent in the inguinal and anal regions.

Granulomata

Syphilis.—*Chancre* is due to *Spirochæta pallidum*. It appears in a variety of forms, occurring usually about three weeks after exposure, never before the tenth day, on the prepuce, the glans or the shaft, or within the urethra. Clinical forms are: (1) Raw erosion—a pinkish to beefy red erosion, approaching a livid purple color, from the size of a split pea to that of a penny. The surface is raw with scanty, bloody serum. Infrequently, a small adherent false membrane is present. It is oval or rounded and usually indurated. (2) Superficial ulceration—an ulcerated ero-

sion; a slight ulcer with adherent sloping borders, a grayish floor with scanty, seropurulent or bloody discharge, and having induration. (3) Herpetiform—a collection of chancrous erosions resembling herpes. Diagnosis made by persistency, moderate induration and later, inguinal adenitis. (4) Mixed chancre—a combination of chancroid and syphilitic chancre, each running its course. (5) Hunterian chancre—one of superficial ulceration. Marked excavation and induration, the ulcer being rounded or oval, funnel-shaped with sloping edges and a pultaceous floor, and surrounded by extensive induration. Thin, putrid discharge. Chancre not painful. The course varies from two weeks to three months. The glands of the groins become enlarged, hard, movable, non-adherent and non-tender in second week. *S. pallidum* found in smears. Wassermann often negative at first. This ulcer has a definite *punched-out* appearance, characterized by indurated and clean-cut edges.

Ulcerated papule occurs during the secondary period of syphilis. It first appears as papules on areas of the penis in which there is least moisture. These rapidly break down, forming more or less superficial ulcers. *Spirochæta pallidæ* are demonstrable in lesions. Wassermann is positive as a rule. There are other secondary manifestations, elsewhere.

Mucous patches consist of minute pinhead to pea or large-sized elevations on the prepuce, usually near the mucocutaneous junction. They are covered with whitish, heaped-up, sodden epithelium, which appears soft and soggy. Other signs of secondary syphilis are present, such as rash, sore-throat, mucous patches of the mouth and indolent adenitis. The initial lesion is often not healed at the time, and the Wassermann reaction is usually positive. They occur six weeks to three months after infection.

Gumma commences on the glans or prepuce as a small, elevated nodule, which, if untreated, breaks down, discharging its sticky contents and leaving an ulcer with a yellowish, sloughing base and thin edges. It may occur on any part of the penis, and may cause a urinary fistula and stricture. No pain is present. History of syphilis. Wassermann reaction is positive.

Actinomycosis is a rare condition and occurs about the meatus, first appearing as a redness of the meatus, this being soon followed by a serosanguineous secretion. Pain is an early symptom. Induration develops, and in this area are small, purulent, knotty masses which soon break down and ulcerate, discharging the typical "sulphur-granules" in the pus, and leaving the glans studded with numerous openings and sinuses. It is progressive and destructive.

Tuberculosis is a rare affection though it has arisen in infants circumcised by the Jewish method. Tuberculous ulcers are shallow, yellowish, with thin overhanging edges and are painful and multiple. They are found on the glans or about the meatus or in the urethra. Isolated masses are found in the urethra and cavernous bodies and are usually about the size of a pea. They enlarge slowly, extending toward the surface, and are felt directly under the skin. They result in ulceration and are accompanied by the formation of granulation tissue which gradually infiltrates the surrounding tissues, and which may involve the entire thickness of the penis. Caseous degeneration occurs in this infiltrate. Rarely, the penis is first affected at the meatus (in tuberculosis of kidney and bladder). There is a swollen, angry appearance, with small miliary tubercles visible on the surface, a seropurulent secretion, and a slight infiltration of adjacent tissue. *Infantile tuberculosis* appears as a tubercle,

a typical yellowish or gray-white speck on a surface of granulation tissue; progressing rapidly and involving inguinal glands.

Tumors

BENIGN

Papilloma.—Warts are frequent, and are not necessarily venereal. They consist of pink, sensitive, vascular, cauliflower-like growths, usually pedunculated and generally multiple. They occur on the prepuce at the junction with the glans, on the glans itself, at or within the meatus and rarely upon the body of the penis. They are often associated with balanitis and have a foul discharge. Ulceration may occur. A true papilloma is rare, and consists of a pedunculated tumor of the skin of the penis or of the mucous membrane, not involving the connective tissue, and sometimes growing to a large size.

Horns are most frequent on the glans. They appear either as firm, flattened horny plaques, or as horny outgrowths of stony consistency. There may be one or more, and are from $\frac{1}{2}$ to $3\frac{1}{2}$ inches long, widest at the base and tapering off toward the distal portion, which is truncated. As a rule there is no pain, but their presence may cause itching and burning sensation. They may prevent coitus and hinder urination. They are, as a rule, found in men from fifty to seventy years, but occur as early as the nineteenth year.

Chondroma is rare.

Condyloma is frequent and not always venereal. It is found most especially in unclean persons. It consists of pink, sensitive, vascular, cauliflower-like growths, usually pedunculated and generally multiple. Condylomata have broad bases, are flattened and present roughened, irregular surfaces. They occur on the prepuce at the junction with the glans, on the glans itself, at or within the meatus, but rarely upon the body of the penis. Balanitis with foul discharge is often associated.

Sebaceous cysts are situated most especially at the hairy portion of the penis. They consist of small, discrete, circumscribed cystic tumors arising as the result of retained sebaceous secretions. They are attached to the overlying skin at one point, but otherwise they are freely movable. They are often multiple.

Dermoid cyst occurs mainly near the raphé of the penis. It is always small and is circumscribed, moderately firm, insensitive, contains hair and sebaceous material, fragments of bone or teeth, and is congenital.

Lipoma; Neuroma; Fibroma.—*Lipoma* of the penis occurs as a single or multiple, soft, lobulated, pedunculated tumor beneath the skin of the penis. It causes no pain. The overlying skin is movable. *Neuroma* and *fibroma* are rare and the two are usually combined as a neurofibroma. They are benign, slow-growing tumors, and usually situated on the body of the penis. They are irregular and nodular, very firm and painless. They may reach the size of a hen's egg.

Adenoma is rare. It may be either single or multiple, and appears as a pea to marble size tumor beneath the skin of the glans or body. It is movable, rounded, firm, painless, and slow-growing.

Nevus is a congenital affection. It is usually a flat patch on the shaft of the penis, brownish or purplish in color, sharply defined from surrounding skin, insensitive, and causing no symptoms. Occasionally it appears as an elevated mass with

an irregular surface, presenting a mulberry or cauliflower appearance, and of dark wine or almost black color. At times, malignant changes develop.

MALIGNANT

Carcinoma is the most frequent tumor excepting the papilloma. It is rare before the forty-fifth year. There is often the history of injury.

Varieties.—(1) Papillary epithelioma appears as a warty nodule on the inner surface of the prepuce, or on the glans. It soon breaks down forming an ulcer with a hard base and hard, everted edges and discharging a foul, thin material. It infiltrates the surrounding tissues causing phimosis or paraphimosis, according to the location. In some cases the warty growth gives rise to new papillary outgrowths of various sizes and shapes, forming a prominent tumor resembling a cauliflower. Portions coming in contact with the urine are soft, the under parts slough and the urethra is often perforated. The corpora cavernosa are later involved, the process extending toward the pubes. There is marked destruction of the tissue. (2) Cancerous ulcer begins on the glans. It is a solid tumor and may reach a considerable size without early ulceration and have the appearance of carcinoma-simplex of the breast, on section. A cancer of the penis involves the penis and inguinal nodes, but metastases to distant organs are rare. The scrotum, testes, groin, bladder, prostate and suprapubic region are involved by continuity. Pain is rather late and radiates into the scrotum, perineum and thighs. The growth bleeds easily but hemorrhages are rare.

Sarcoma is primary or secondary. All forms, including fibrosarcoma and angiosarcoma, consist of firm or elastic nodules in the body of the penis or the glans, followed later by dense infiltration. Secondary tumors in the groin, testicles and prostate occur early, but ulceration is late. Deformity of the penis and angulation during erection may be early symptoms. Dysuria is present when the urethra is compressed.

Intravascular Endothelioma.—The clinical picture is the same as in sarcoma. It is rare.

Other Affections

Rare conditions include noma, diphtheria of the prepuce, erysipelas of the penis, and lupus erythematosum.

AFFECTIONS OF THE URETHRA

Injuries

Injuries of the urethra are of common occurrence and may be brought about by direct violence or in the course of instrumentation with the formation of a so-called "false passage."

Contusions of the urethra are met with, following a direct trauma to the genital tract, though it is rare for such an occurrence to exist without evidence of trauma to some other portion of the tract; on the other hand, a contused urethra is of frequent occurrence following instrumentation with or without the formation of a false passage. The symptoms depend for the most part on the location of the con-

tusion and upon the severity of the injury. The symptoms in general are those of soreness or discomfort over the site of injury, perhaps radiating to the penis, bladder or testicles, which discomfort is markedly increased on urination and by erection. The occasional passing of a few drops of blood prior to micturition is inconstant, but often present.

Rupture of the urethra, on the other hand, is attended by more severe symptoms, their intensity depending upon the extent of the damage to the canal and to the portion of canal involved. A false passage occurring during instrumentation and only involving the mucous membrane and some of the muscle-fibers of the urethra may only be attended by the symptoms referable to those present in a contusion, with perhaps, added to them, frequent micturition and an intensity of pain on urination with a urethral hemorrhage varying from the passing of a few drops of blood to a thin, but steady, flow which is independent of micturition. Complete *urinary retention* may ensue. If a rupture occurs in the floor of the urethra and behind a stricture, there is a probability that a small amount of *extravasation of urine* may occur which infiltrates into the periurethral tissues, which in turn may bring about a periurethral abscess; the formation of such an abscess, however, depends upon whether or not infection has occurred, in which case it is quite probable that an abscess will form; if, however, the urine remains sterile, a protecting exudate may form about the rupture and instead of an abscess forming, scar tissue replaces the plastic lymph leading to a final disposition of cicatrization, which forms about the old site of injury, leading to a hard and perhaps boardlike tissue, which eventually is apt to cause further stricture formation. Rupture in the pendulous portion of the urethra is attended by a fairly rapid infiltration of urine over the penis, causing it to become markedly swollen and indurated with an accompanying pain and a gradual extension of the urine into the scrotum and surrounding tissues. The scrotum, and often the perineum, becomes swollen, and induration and scrotal, perineal and penile fistulae are not infrequently found. If the rupture includes the corpora cavernosa, the urine rapidly infiltrates to the glans, which in turn may become gangrenous. An involvement of the penile urethra is attended with less stormy symptoms and may lead to the formation of local ulceration of the skin, with the formation of a penile fistula. The most serious, and at times dangerous, extravasations of urine are brought about when the urethra is ruptured at the bulb, membranous portion or between the attachment of the scrotum and either the anterior or posterior leaflet of the triangular ligament; rapidly developing cellulitis ensues, causing a diffuse swelling in the upper portion of the perineum and the lower areas of the scrotum with a gradual extension of the infiltration to the lower part of the abdomen. Constitutional symptoms may become marked, including rapid pulse, elevated temperature, cold and clammy skin, nausea and perhaps vomiting. The giving way of the posterior leaflet of the triangular ligament affords an opportunity for the urine to extend along the course of the rectum with the formation of a mass which finally becomes an abscess. At times, so extensive is the extravasation of urine, that an invasion and infiltration of the subperitoneal tissues occur. Pelvic peritonitis, with perhaps the involvement of the space of Retzius, presents as a fairly late complication. The toxic symptoms suddenly may become pronounced and the patient may die from a general intoxication.

The inflammatory conditions are not discussed.

Stricture

Congenital stricture of the urethra is rare but when present involves either the meatus or the bulbomembranous junction. In any case there is difficulty in urination with a resulting small stream. If the meatal end is narrowed the penile urethra may be felt distended when there is an attempt to force the urine through. In any case the diagnosis can be made by catheterization.

Tumors

Tumors of the urethra are very uncommon. The form most frequently found is the papilloma which is present as a caruncle, polypus or a papillomatous vegetation. Many cases seem to follow the irritation of a chronic urethritis. Malignant tumors are even more rare than the benign types. Primary carcinoma has been reported; difficulty in urination with bleeding are important symptoms.

Calculi

Calculi in the urethra may be of long standing or recently passed from the kidney or bladder. In the latter case, the onset is sudden after an attack of renal colic or irritability of the bladder. There is pain coming on during urination, with cessation of the stream or diminution to a few drops at a time, dependent on the size of the stone. Erections are frequent, with slight or severe hemorrhage. In chronic cases where the calculus has become imbedded there will be but little obstruction to urination and pain will be absent, or slight. Complications and sequelæ are periurethral abscess, stricture or even rupture. If the stone is in the penile portion, it may be detected by palpation; if in the posterior part, by digital examination of the rectum. X-ray, endoscopy and insertion of a stone searcher will aid in the diagnosis.

Foreign Bodies

Foreign bodies in the urethra will give rise to severe, stabbing pains if the object is rough or sharp. There will be a frequent and urgent desire to urinate, but passage of only a small stream may be possible. Acute inflammation with swelling of the penis may be induced, especially if the foreign body is in the anterior portion. When in the posterior part, pain will be felt in the perineum and strangury or retention occur. Orchitis may follow.

Granulomata

Intra-urethral chancre occasionally occurs. On palpation, the canal will be felt indurated, there will be a small amount of mucoid discharge at the meatus, in which spirochetes may be demonstrated. There will be no blood or pain and eventually the inguinal glands will be enlarged. The history and the Wassermann reaction will aid in the diagnosis.

Tuberculosis of the urethra may be primary or secondary. The primary form is rare, but probably occurs more often than is commonly supposed. Males are more frequently attacked than females. Usually there is a history of an old chronic in-

flammatory condition of the genital tract which has been complicated by orchitis or epididymitis. Symptoms are often vague, the most common being frequent micturition with intermittent attacks of dysuria. Of greatest diagnostic importance is an unexpected ejaculation of bloody semen. The tubercle bacilli may be found in the seminal fluid or urine. With the aid of the endoscope, superficial ulcerations may be seen near the ejaculatory ducts or in other parts. The secondary form manifests itself by a chronic urethritis, which refuses to respond to treatment. There will be dysuria, occasionally perineal pain, tenesmus and perhaps hematuria. Symptoms of the primary tuberculous condition usually aid in the diagnosis.

Fistulæ

Fistulæ of the urethra take their distinctive names from the position of their opening and course in the urinary tract. The superficial opening is generally observed on the dorsal surface of the penis, scrotum or perineum, but occasionally it appears in the buttocks, thigh region and, only rarely, in the lower portion of the abdomen. So far as the cutaneous opening is concerned, it may be so small as to allow the entrance of only the most minute wire, while on the other hand, due to devitalized tissue, it may be so large and extensive as to admit a fair-sized probe. In one case the fistulous tract may be tortuous and extremely irregular, while in another instance it may lead directly to the urethra. The etiology of a urethral fistula is wide and varied, the most common causes being: (1) Urethral stricture with, or without, the formation of a false passage; (2) urethral rupture with an extravasation of urine; (3) periurethral abscess; (4) fixity or impaction of a sharp body such as a calculus or object introduced into the urethra; (5) any suppurative process which might modify the penis, urethra or scrotum; (6) penile gangrene; (7) rarely, complete ulceration of a urethral tumor, and (8) prostatic abscess. The fistulæ which are most commonly found are the *perineal* and *scrotal fistulæ*, which so often follow a rupture of the posterior urethra, either occurring during the course of an instrumentation and the formation of a false passage or from direct traumatic rupture. In these cases the fistulous openings may be single or multiple, usually single, and the cutaneous opening is small unless the inflammatory process is of a virulent type. The course may be markedly tortuous, but as a rule, the probe will easily reach the urethra without difficulty. The perineum or scrotum is often hard and indurated and single or multiple abscesses about these regions are not uncommon. The *urethro-penile fistula* is uncommon and is generally caused by a gangrenous condition of part or whole of the penis brought about by a constricting band, though a phagedena with formation of a periurethral abscess is recognized as a causative factor. A short and straight course of the fistulous tract with opening in some portion of the urethra is found. A manual attempt at closing the opening when patient urinates will aid in the diagnosis.

AFFECTIONS CAUSING SCROTAL ENLARGEMENTS

(Including Affections of Testicle, Epididymis and Spermatic Cord)

The following pages refer to conditions in which there is an enlargement of the scrotum due to one of many causes. Thus, if a physician on inspection sees an

enlarged scrotum, whether it be uniformly enlarged or not, certain conditions of pathology will be present and he will ask himself: "What causes the enlargement?" Any one of the conditions cited in the chart may be the cause, and it is for him to differentiate by history taking, inspection and palpation, the proper interpretation of the condition.

Acute congestion of testicle or epididymis

Hematoma

Urinary extravasation (traumatic or pathologic)

Edema (traumatic) or from nephritis

Inflammatory conditions	{	acute orchitis (bacterial)
		acute epididymitis (bacterial)
		acute inflammation of scrotum (chemical)
		abscess (pyogenic)

Hydrocele	{	acute
		chronic
		congenital

Varicocele

Elephantiasis

Scrotal edema (acute nephritis)

Granulomata	{	tuberculosis
		syphilis

Cyst	{	retention of testicle
		retention of epididymis
		retention of scrotum
		sebaceous
		echinococcus
		cystic disease of scrotum
		chylocele

Hypertrophy of scrotum

Tumors	{	benign	{	lipoma
				chondroma
				osteoma
				fibroma
				myxoma
				angioma
				adenoma
				spermatocele
	{	malignant	{	sarcoma
				carcinoma
				epithelioma ("chimney sweep's cancer")
				teratoma (benign or malignant)
				synectium

Hernia (complete inguinal)

History

Age; Occupation; Nativity

Family History.—Tuberculosis, cancer and other tumors, syphilis.

Personal History.—Acute infectious diseases. Complete venereal history, including dates. Excessive venery and masturbation. Stricture with instrumentation; injury, history of rupture. Habitat in foreign country. Habits of bowels; indigestion; mumps.

Present Illness.—Date of onset and character (acute or gradual). Direct relation, if any, between venereal history and present condition; recent instrumentation. Cough, chills and fever. Is mass increased on standing? Pain: character and radiation. Nausea and vomiting. Date of last bowel movement.

Physical Examination.—Contour of scrotum. Is mass uni- or bi-lateral? Does mass become smaller on manipulation or when patient is in a recumbent position? Condition of scrotal skin, presence of sinus. Dull or tympanitic, fluctuant or solid, stony hard or soft, regular or nodular. Movable or fixed; signs of inflammation. Does mass involve testicle or epididymis, or both? Presence of wormlike tissue in scrotum and about testicle. Gurgling sounds. Wassermann and response to KI. Aspiration, leukocytes, examination of urethral discharge. Examination of rectum. Transmitted light. Impulse seen and felt on coughing.

INTERPRETATION OF HISTORY

Age.—*Infancy and Childhood.*—Complete indirect hernia, injury, congenital malformation (hypertrophy), acute hydrocele, malignant tumor (sarcoma).

Puberty and Early Adult Life.—Hernia, acute epididymitis (gonorrheal), chronic or acute hydrocele, varicocele, tuberculosis of the epididymis, tumors benign, tumors malignant (sarcoma), syphilis.

Adult Life.—Same as puberty and early adult life with perhaps malignant tumor (mixed and carcinoma) added.

Advanced Adult Life.—Same as puberty and early adult life and adult life with cystic disease and malignant tumor (cancer) and hernia added.

Old Age.—Cystic disease, carcinoma, hernia.

Occupation.—Those doing hard work are subject to hernia and injuries; chimney sweeps, to epithelioma.

Personal History.—*Acute infectious diseases*, such as diphtheria, scarlet and typhoid fevers, smallpox, etc., may bring on an acute orchitis or epididymitis. In other words, any acute infection may show metastatic presence of inflammatory grades in testicle or epididymis.

Complete Venereal History.—Acute gonorrheal epididymitis, syphilis of the testicle, acute hydrocele, chronic hydrocele, acute inflammation of the spermatic cord.

It should be remembered that gonorrhea is more apt to affect the epididymis, while syphilis has a predilection for the testicle. At times, though rarely, both testicle and epididymis are involved in the same process. A chronic, and, at times, an acute hydrocele may also appear as a complication of gonorrhea. A markedly acute inflammation of the spermatic cord with a spreading downward into the scrotum may accompany an acute gonorrhea.

Excessive Venery and Masturbation.—Acute congestion of testicle or epididymis or both, varicocele.

Stricture with Instrumentation.—Acute inflammation of testicle, more especially epididymis, or both, extravasation of urine, hematoma, scrotal edema (traumatic). The above conditions may be due to the formation of “false passages” by the passing of a sound through the posterior or even through the anterior urethra.

Injury.—Contusion, acute congestion of testicle, epididymis or both; traumatic edema of scrotum, acute inflammation of testicle or epididymis, or both; hematoma, often the cause of acute or chronic hydrocele, retention cysts, rupture of urethra.

History of Rupture.—Hernia.

Habitat in Foreign Countries.—Elephantiasis, epithelioma of scrotum.

Habit of Bowels and History of Indigestion.—Hernia (in incarcerated hernia, we may have marked obstipation or perhaps frequent digestive disturbances).

Mumps.—Acute inflammation of testicle, possibly of epididymis.

Present Illness.—*Rapid Onset.*—Acute congestion of testicle or epididymis, hematoma, scrotal edema, urinary extravasation, acute orchitis, acute epididymitis, acute inflammation of the spermatic cord, acute inflammation of scrotum, abscess, acute hydrocele, scrotal edema (acute nephritis), mixed tumors, sarcoma, hernia.

Gradual Onset.—Urinary extravasation, abscess, chronic hydrocele, congenital hydrocele, varicocele, elephantiasis, scrotal edema (acute nephritis), tuberculosis, syphilis, retention cyst, sebaceous cyst, echinococcus cyst, cystic disease of scrotum, hypertrophy of scrotum, chylocele, benign tumors, carcinoma, epithelioma, mixed tumors, hernia.

Cough.—Tuberculosis of the epididymis is often accompanied with the above symptom, since tuberculosis of the testicle is often secondary to pulmonary tuberculosis, or vice versa.

Chills and Fever.—Urinary extravasation with infection, the acute inflammatory conditions including abscess, tuberculosis (occasionally).

Mass Increased on Standing.—Refers especially to hernia and perhaps retention of urine within the scrotum.

Pain (Sharp or Dull).—The amount of pain will vary, depending upon the size, situation and pathology of the affection. It should be understood that any growth situated upon a large or even a small nerve may cause the symptom of pain.

Nausea and vomiting may be decidedly misleading symptoms in as much as acute conditions of the testicle and epididymis may bring about as much distress and gastro-enteric discomfort as a strangulated or incarcerated hernia.

Date of Last Bowel Movement.—This part of history is important from the standpoint of the presence of a hernia which has become strangulated.

Mass (Unilateral or Bilateral).—The vast majority of scrotal affections are unilateral, though the following conditions are, as a rule, bilateral: elephantiasis and the scrotal edemas of nephritic etiology. Urinary extravasation is usually bilateral.

Impulse on coughing refers to herniæ.

Urinary extravasation into the scrotum is caused by trauma to the urethra (which see).

Edema of the scrotum follows trauma or occurs in advanced cases of nephritis.

History with edema elsewhere and urinary findings will give the diagnosis.

Acute Congestion

Acute congestion of the testicle or epididymis may follow blows, acute hernia with pressure on the spermatic cord, torsion of the cord, or occurs in acute, non-specific idiopathic inflammation. The testicle will be swollen and painful; the underlying condition will aid in the diagnosis. The condition responds readily to conservative treatment when the cause is removed.

Hematoma

Hematoma of the scrotum follows a severe injury with extravasation of blood outside the tunica vaginalis. The swelling is shaped as an inverted pear, extending up along the cord. The amount of blood escaping varies, at times being very great. When the hemorrhage is within the tunica vaginalis, the term hematocele is used. This is rarer than hematoma. It results from blows or follows the puncture of an hydrocele. Absorption is not as prompt as in hematoma and formation of a fibrinous exudate with chronic swelling is common.

Inflammatory Conditions

Inflammations of the testicle are common. Acute orchitis of a bacterial nature is most frequently due to extension of a gonorrheal infection from the urethra. The epididymis is involved first. The condition follows an involvement of the posterior or prostatic urethra. The testicle becomes swollen, painful and extremely tender. The swelling is of a globular shape and the pain radiates toward the back and groins. Temperature of 103° with signs of toxemia is present. Vomiting and constipation occur. The skin of the scrotum becomes red, edematous and infiltrated. Suppuration may occur but more commonly, atrophy of the testicle is the result. Acute chemical inflammation of the scrotum occurs in workers in tar and paraffin and in chimney sweeps. It is due in part to friction of dirty clothes. Early stages are manifested by chronic eczema followed by warty outgrowths, which frequently undergo malignant changes. Abscess of the scrotum follows infected penetrating wounds, orchitis, or disintegration following extravasation of urine. Exact symptoms will depend on the causative factors.

Hydrocele

Hydrocele is a collection of fluid, usually serum, but not pus or blood, in the region of the testicle or spermatic cord. A congenital form occurs when the funicular process remains patent; this allows the fluid to be reduced into the abdominal cavity. Acute hydrocele occurs in the course of an acute gonorrheal epididymitis, tuberculosis, syphilis, mumps or typhoid fever. There is an acute onset, pain and tenderness, sense of fluctuation and a translucent swelling. Chronic hydrocele is

common, occurring about three times as frequently in adults as in infants. The onset is insidious, the course slow. It follows trauma, congestion of the cord or the acute form.

Usually the first symptoms are those arising from an enlarged scrotum, heavy weight and friction from clothes. The swelling is pear-shaped, gives a sense of fluctuation and is translucent to light. The sac wall increases in thickness as the fluid increases in amount; many ounces may be present. If necessary, a puncture may be made to confirm the diagnosis. Hydrocele must be differentiated from (1) hernia which can be reduced on lying down, is worse on coughing, has a sudden onset and is not translucent; (2) abscess which gives history of infection, is not reducible, or worse on coughing, not translucent, is accompanied by temperature and yields pus when punctured; (3) spermatocele which is not translucent and yields spermatozoa when aspirated; (4) hematocele which occurs suddenly after injury and on early tapping, blood escapes; (5) tumors of the testicle which are firm, solid, not translucent, grow rapidly and often give rise to local pain; (6) tuberculosis of the epididymis which follows the same disease elsewhere in the genito-urinary tract, is accompanied by frequency of urination, burning, temperature, cloudy urine and gives a positive guinea-pig inoculation test; and (7) syphilis of the testicle which follows luetic infection, is a slow, smooth enlargement, painless, dense and responds to antisyphilitic treatment.

Varicocele

Varicocele is a varicose condition of the veins of the spermatic cord. It occurs in young adults; in old men it is a chronic condition or the result of malignant changes in the kidney. The left side is more commonly affected than the right. The resultant swelling of the scrotum is soft and irregular. The dilated veins can be seen through the skin and feel like a bundle of worms in a bag. When the patient lies down the swelling nearly disappears. Slight aching and heaviness of the scrotum and occasionally, neuralgic pains in the testes are complained of. Atrophy of the testicle may result.

Elephantiasis

Elephantiasis of the scrotum is the result of chronic lymphatic obstruction. The most severe forms are caused by the *Filaria sanguinis hominis*, and occur in the tropics; milder forms are due to tuberculous or cancerous involvement of lymph glands, operative removal of the glands or recurrent attacks of lymphadenitis. The scrotum is enlarged, the skin dense and firm and covered by papillomatous growths.

Granulomata

Tuberculosis of the testicle occurs in young adults suffering from that disease in some other organ, usually the kidney, but it may occur as a primary condition in the epididymis. Generally only one side is involved. At the onset the condition may simulate an acute orchitis, but the swelling persists and a typical tuberculous abscess forms. The disease may appear as a slowly developing, firm, painless, *nodular*

swelling of the epididymis, which forms a crescentic edge on the testicle. There will be frequency of urination with burning, and there may be a passage of cloudy urine. Temperature will be present. Tenderness is often to be found in the perineum or prostate. Neuralgia of the cord increases as involvement slowly extends. When disintegration occurs, the overlying skin becomes adherent, red and congested and a tuberculous abscess forms. Sinuses are common.

Syphilis of the testicle occurs in the testicle proper (*in contrast to tuberculosis, which attacks the epididymis*) in the later secondary or early tertiary stage. The latter is by far the more common, a gummatous swelling appearing even twenty years after infection. The tumor mass is very hard, regular, globular, often accompanied by a hydrocele. There is no pain, nor is the cord usually involved. As the disease progresses, one part of the organ disintegrates, becomes swollen and painful, then soft and fluctuating and finally a characteristic gummatous discharge escapes. A deep, sloughing, syphilitic ulcer may form. The testicle usually atrophies unless the condition is controlled early by antisyphilitic treatment.

Cysts

Cysts of the testicle, epididymis or scrotum are rare. Dermoid cysts have been reported in this region. More common are the simple cysts or spermatoceles. These are usually placed between the head of the epididymis and the testes and vary in size from that of a cherry to that of an egg. Development is slow and painless. Symptoms arise only from size and weight.

Tumors

Benign tumors of the testicle are rare. Fibroma and lipoma are the most common; adenoma or fibrocystic disease is occasionally found. Of the *malignant growths*, sarcoma is fairly common, occurring in children and young adults. They seem to arise more frequently in undescended testicles than those in the scrotum. The course is usually rapid. Early symptoms are only those of weight and dragging sensation; later, when the condition has extended up the cord, there will be pain and cachexia. By far the greater number of testicular tumors are carcinomata, usually appearing after thirty-five. The mass is fairly regular, very hard, without acute symptoms. Involvement of the inguinal and retroperitoneal lymph glands occurs early. The more rapid the growth, the more severe the pain will be in the testicle. Epithelioma or chimney sweep's cancer usually follows a chronic eczema caused by the friction of dirty clothes. Teratoma occurs just as in the ovary, usually in early age, but may not be manifest until adult life. They are essentially benign, but may undergo malignant changes at any time.

Hernia

A complete inguinal hernia causes a scrotal swelling which is soft, regular, causes a bulging in the inguinal region, is reducible through the inguinal (internal) ring unless incarcerated and gives a distinct impulse on coughing. See section on "Hernia."

AFFECTIONS CAUSING HEMATURIA

Kidney	infections	{	acute parenchymatous nephritis
			chronic parenchymatous nephritis
			pyelitis
			pyelonephritis
			pyelonephrosis
	tumors	{	perinephritic abscess
			tuberculosis
			hypernephroma
			carcinoma
			sarcoma
		{	papilloma (intrapelvic)
			angioma of renal pelvis
			injury, trauma
			nephrolithiasis
			cysts
simple cyst			
echinococcus cyst			
infarction			
hydronephrosis			
chronic passive congestion			
nephroptosis			
so-called "bleeding kidney"			

Ureter	{	calculi
		polypus
		Dietl's crisis

Bladder	{	infections	{	acute cystitis
			chronic cystitis	
			gonorrheal cystitis	
			tuberculous cystitis	
			pericystitis	
	{	trauma	{	injury (penetrating objects)
			foreign bodies	
			calculi	
	{	tumors	{	papilloma
			carcinoma	
		diverticulum		
		ulcer		
		exstrophy		
		parasites		
		ruptured veins (rare)		

Prostate	{	hypertrophy
		infection (simple)
	tumors	{
		malignant

(Continued on page 270)

Symptom	Nephrolithiasis	Tuberculosis of Kidney	Carcinoma of Kidney	Acute Nephritis
Age	Usually adults.	Any. Especially third, fourth decade	Usually after 45.	Any.
History and onset	Calculus may be present for years without symptoms. Sedentary life. Excessive ingestion of nitrogenous food and alcohol.	Indefinite history of cystitis for several weeks. Slight polyuria and small amount of pus with trace or large amount of blood in urine.	Small amounts of bleeding over period of weeks, without explanation.	Often follows an acute infectious disease. Cold and exposure, ingestion of toxic substances. Pregnancy or extensive burns. Onset may extend over a few days.
Pain (type and radiation)	Dull and persistent over kidney region, with acute exacerbations. Exacerbations are exhibited by sudden, severe stabbing pain in kidney region radiating down thigh or into testicle. Attack may last from few minutes to few hours; subsides suddenly or gradually.	Usually a dull, persistent ache in kidney region. At times, cystitis causes painful urination. Paroxysms of renal pain occur.	Aching and discomfort in kidney region. At times, there are paroxysms of acute renal pain.	Persistent, moderate pain in back over both kidneys. May be entirely absent.
Mass	Kidney often somewhat enlarged, but no definite mass.	In some cases, kidney moderately enlarged. No mass present.	Tumor palpable in kidney region, only in late stages.	None, clinically.
Tenderness ..	At times, exquisite in costovertebral angle.	Usually slight, over kidney region. May be entirely absent.	Usually slight.	May or may not be. If present, slight.
Cystoscopy ..	Shows from which ureter blood is coming. With ureteral catheterization and suction, fragments of uric acid may be obtained. Renal bougie coated with wax may be scratched by calculus.	Turbid urine from ureter of diseased side. Catheterization of ureters may be necessary. Examinations of separate specimens from each side for tubercle bacilli; guinea-pig inoculations from specimens obtained from both sides. Determines whether bladder is involved; trigone frequently involved.	Usually shows normal bladder and from which kidney blood is coming.	Shows blood and highly concentrated urine escaping from both ureters. Bladder normal.

OF HEMATURIA

Cystitis	Tumor of Bladder	Bladder Calculus	Symptom
Any. Usually 50-60.	Usually 50-60.	Early childhood. Especially in middle age.	 Age
Usually secondary to other disease of genito-urinary tract. Instrumentation or retention. Prostatic disease, bladder calculus. In course of or after an acute infectious disease.	History of chronic irritation or growth in rectum, prostate or uterus. Benign tumor may become malignant.	May be history of renal colic. Usually preceded by retention and symptoms of cystitis.	.. History and onset
Acute, burning pain felt above the pubis, perineum or groin which often extends into thighs. Urgency of urination with frequent passing of small amounts of urine. Painful straining and tenesmus, common. Rectal examination often causes pain.	Not usually severe in early stages, but as disease progresses, pain may become of most extreme type.	Sharp burning in glans, at end of micturition which generally disappears as bladder fills. More severe when there is a cystitis and after exercise (especially in early cases). Often no pain when stone is encysted. Reflex pain common in rectum and perineum.	... Pain (type and radiation)
Not present.	Possibly detected by bimanual examination. Extension to neighboring structures often.	Not present.	 Mass
In suprapubic region. Often more marked on suddenly withdrawing hand than by deep pressure.	Not present unless there is a pronounced secondary cystitis.	May be slight suprapubic tenderness, may be marked, if severe cystitis.	.. Tenderness
Inflammation of bladder wall with blood and mucus. Ulceration, injection, sloughing or false membrane may be present.	Growth may be seen and a portion removed for examination. Malignant growth often easily felt with sound or catheter and bleeding follows its removal.	Calculus readily seen, unless it is situated in a diverticulum or behind an enlarged prostate gland. Stone may be touched with sound or catheter and contact felt, perhaps heard.	.. Cystoscopy

Symptom	Nephrolithiasis	Tuberculosis of Kidney	Carcinoma of Kidney	Acute Nephritis
Urine	Bleeding, rarely profuse and when present, usually diminished by rest. Often appears abruptly, following heavy exercise. May be smoky or contain only microscopic blood. Blood found in about one-half of cases. Perhaps calculus or bits of same. Pyelitis occurs and pus noted.	Tubercle bacilli are usually found if the specimen has been carefully examined following its having been well centrifuged. The organisms often occur "in showers." Polyuria, most troublesome, at times, both night and day. Amount of blood usually small; in rare cases, bleeding is profuse. Usually large amount of pus.	Blood may appear early and in small amounts, but it is persistent. May have blood-casts of ureter or kidney pelvis. Tumor cells are rarely found.	Small in amount. High specific gravity; deeply colored, from smoky to deep red. Contains blood, gross or microscopic, hyaline and blood-casts. Albumin abundant.
Special data.	General health good, until suppuration within the kidney occurs. In the acute attacks, chills and fever often present. Radiograms usually show calculus.	General health usually poor, with possibly the presence of pulmonary tuberculosis. Possibly other involvement. Loss of weight. Nocturnal fever and sweating not uncommon. In early stages, health may appear normal. Usually secondary to tuberculosis of bladder, prostate or seminal vesicles. Tuberculin may give positive reaction.	General health good until disease is well advanced, then increasing cachexia.	Pallor and rapidly developing edema of face and ankles. Nausea and vomiting may occur. Chills and high fever, common at onset. Often convulsions.

OF HEMATURIA (*Continued*)

Cystitis	Tumor of Bladder	Bladder Calculus	Symptom
Becomes increasingly cloudy and full of mucus and pus cells. Often contains variable amounts of blood. Loaded with bacteria.	Bleeding, intermittent. Blood at end of urination and often profuse. Urine mixed with blood-clots, possibly tumor fragments. With secondary cystitis, loaded with pus and blood.	Urination frequent and may be involuntarily arrested suddenly. Desire to urinate is sudden, uncontrollable and aggravated by exercise, and is more frequent in daytime. Blood may or may not be present; it is found in well-developed cases at end of urination. With cystitis, loaded with pus.	 Urine
Slight fever often present. With retention, perhaps high fever and chills. Acute and chronic forms. Always caused by microorganisms. Infection aggravated by retention, calculus or tumor.	In early stages, health good. Later, if malignant, cachexia may be marked, with involvement of rectum; metastasis to lungs common. Hydronephrosis may develop. May be difficulty in beginning of urination, "stammering of bladder."	General health unimpaired. May be slight impairment of health due to loss of blood or cystitis. Calculi are usually of renal origin. May be history of renal stone. Rare in females. Priapism often present. Radiograms usually show presence of calculus.	Special data

- Pelvic affections { pelvic abscess
pyosalpinx
intestinal tuberculosis
with appendicitis
- General systemic conditions { purpura hæmorrhagica
hemophilia
polycythemia rubra vera
chronic myeloid leukemia
lymphatic leukemia
pernicious anemia
familial hematuria
septicemia
tabes dorsalis
scurvy
eclampsia
idiopathic hematuria (essential)
- Infectious diseases { typhoid fever
malaria
smallpox
typhus fever
yellow fever
icterohemorrhagic spirochetosis (Weil's disease)
- Irritating drugs { turpentine
cantharides
carbolic acid
phosphorus
potassium chlorate
- Parasites { *Filaria bancrofti*
bilharziasis
- After strenuous exercise or exposure to cold

AFFECTIONS CAUSING PAIN IN THE BACK

Vertebræ	infections	- acute osteomyelitis - infective spinal arthritis - spondylitis deformans - hypertrophic arthritis - osteitis deformans - osteomalacia - Bechterew's spondylitis - tuberculosis (Pott's disease) - typhoid - gonorrheal spinal arthritis - syphilis
	injuries	- fractures - sprains - lumbosacral strain - sacro-iliac strain - vertebral subluxation
Spinal cord	deformities	- sacralization of fifth lumbar vertebra - scoliosis, lordosis, kyphosis
	neoplasms	- benign - myeloma - osteoma - malignant - carcinoma (primary or metastatic) - sarcoma
	infections	- acute myelitis - acute poliomyelitis - cerebrospinal meningitis - tuberculous spinal meningitis - syphilis - chronic meningomyelitis - tabes dorsalis - Erb's syphilitic spinal paralysis - hypertrophic pachymeningitis
Muscles	injuries	- intraspinal hemorrhage (extradural and subdural) - spinal meningeal hemorrhage - hematomyelia - syringomyelia
	neoplasms	- sarcoma - carcinoma - glioma
Kidney	infections	- lumbago - traumatic strain - attitudinal strain - myalgia
	infections	- acute nephritis - pyelitis - pyonephrosis - pyonephritis - pyelonephrosis - perinephritis - perinephritic abscess - tuberculosis

Kidney (<i>cont.</i>)	{	congenital deformities	{ polycystic kidney nephroptosis
		blood-vessel affections	{ renal artery infarction aneurysm renal artery
		nephrolithiasis	{ with colic without colic
		tumors	{ renal perirenal hypernephroma
Abdominal and pelvic affections	{	gastro-intestinal tract	{ ulcer stomach carcinoma stomach chronic gastritis carcinoma liver volvulus fecal impaction visceroptosis lumbar hernia
			aorta { aneurysm
			spleen { splenomegaly chronic splenitis
			female genital organs { malpositions of uterus salpingitis tumors relaxed vaginal outlet
			bladder { chronic cystitis
			prostate { chronic prostatitis
			retroperitoneal tumors
			Thoracic cavity { mediastinum { tumor abscess
Feet { pes planus			
Herpes zoster			
General body conditions	{	anemia	
		fatigue	
		postoperative backache	
		acute infectious disease	
Neurasthenia	{	"railway spine"	
		compensation or traumatic neurosis	

History

Age; Sex; Occupation

Family History.—Tuberculosis, cancer and other tumors, rheumatism, syphilis, spondylitis deformans.

Personal History.—Acute infectious diseases, venereal history, tuberculosis, rheumatism, injury, gastro-intestinal history, cardiorespiratory history, genito-urinary history, orthopedic history, focal infections, teeth, sinuses, etc.

Present Illness.—Date of onset and character. Pain: type, situation, radiation. What intensifies or lessens pain? Most comfortable position; condition of back in morning; pains in other joints. Paralysis and anesthesia; limitation of motion of spine, deformity, duration, progression. In women, relation of pain to menstrual period, pregnancy.

Physical Examination.—General body condition. Back-deformity or mass, location, size, shape, consistency, mobility; limitation of motion on flexion; extension, lateral bending, rotation of trunk; tenderness, location, extent. Gait: motion of spine when walking; paralysis. Feet: pes planus or other deformity. Abdomen: complete examination for tumor, tenderness, position of viscera. X-ray of vertebral column. Tuberculin.

REFERENCES

STRICTURE OF THE URETER

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— Johns Hopkins Hosp. Bull., Jan. 1918, 39:323. Ureteral stricture. Report of one hundred cases.
OCKERBLAD, N. F. J. Am. M. Ass., Feb. 19, 1927, 88:544. Stricture of the ureter in males.

Symptom	Nephrolithiasis	Tuberculosis of Kidney	Nephroptosis
Age	Usually middle adult life.	2-3 decades, or very young or aged.	Any. Frequently latent until adult.
Onset	Renal colic may be first symptom.	Insidious. General health often good, until disease is far advanced.	May exist for years without symptoms.
Subjective signs and symptoms	Pain: (1) Constant, localized, dull in renal region. (2) Paroxysms of severe, along ureter or into flank. (3) Flashes of, passing to back, groin, testicle or penis (Osler). At times may radiate over abdomen or be localized to side affected. May be very intense. Nausea, vomiting often present. No temperature, unless pyelitis present. Recurrent attacks.	Pain may or may not be present; often dull aching in lumbar region or affected side. Temperature may be normal but it is often irregularly elevated. As disease progresses, symptoms of bladder irritation develop and loss of weight and strength ensue.	Pain: Dull ache in lumbar region with sense of dragging and weight. If twisting of ureter occurs, symptoms of renal colic. Temperature normal.
Objective signs	During attacks, rigidity and tenderness in lumbar region, which may remain sore and tender after attack (few hours or days). Costovertebral angle tenderness and spasm common (during attack). No mass, unless hydro- or pyonephritis develops.	May or may not be slight tenderness over affected kidney. As a rule, no muscular rigidity. Rarely, affected kidney felt in front, on deep palpation.	No true rigidity or tenderness unless hydro-nephrosis or pyonephrosis present. Movable kidney if grasped firmly may be somewhat sensitive. At times can be moved far below normal level. Often moves downward with respirations. In a truly movable kidney, range of mobility very marked. May be enlarged, if twisted.
Urine	Frequency, with slight hematuria. Small calculus or crystals may be passed. Usually microscopic blood in urine, for hours, perhaps days, following an attack.	Frequency, hematuria, pyuria. Tubercle bacilli occur in showers, and demonstrated in centrifuged specimen. Guinea-pig inoculation positive.	Normal. After twisting has subsided, increased amount, at times, blood, pus cells, albumin and casts.
Cystoscopy and radiography	Examination with cystoscope may fail to show urine from affected kidney; at other times, blood and pus. Catheterization with wax tipped catheter will often show scratches. Pyelogram important: usually reveals stone; during attacks of colic, calculus may be found in ureter.	Usually bladder (trigone) involvement. Pus and perhaps blood observed through affected ureter. Radiograms usually negative. In very advanced cases may show enlarged kidney with calcareous deposits.	Normal findings by cystoscopy. Radiograms may show kidney misplacement.

PAIN DUE TO KIDNEY AFFECTIONS

Hydronephrosis	Acute Nephritis	Pyelitis	Symptom
Any. Especially adults.	Any.	Any. Common in infants, pregnancy and generalized infections.	 Age
Depends on cause: usually progressive.	Usually sudden.	Sudden or insidious, depending on cause.	 Onset
Pain: Usually not marked in incomplete case. Where urinary stoppage is complete, attack resembling renal colic, which disappears upon the passing of large quantities of urine. No temperature, unless infection occurs.	Pain varies from dull ache to acuteness, over both kidney regions.	Pain: Absent or mild over one or both kidney regions. Temperature of an irregularly high type, often present. Chills common. May be symptom of an acute cystitis.	.. Subjective signs and symptoms
If symptoms come on rapidly, tenderness and rigidity in lumbar region may be marked. Mass in renal region may be very large and confused with an abdominal tumor. Always posterior to colon.	Hyperalgesia over lumbar region running around toward umbilicus. Slight rigidity. (Rare.)	Often tenderness and rigidity on deep pressure in costovertebral angle. No mass.	.. Objective signs
May be reduced in amount, with sudden liberation of large quantity. Usually negative findings. May be slight hematuria and pyuria.	Small amount, high specific gravity. Highly colored, large amount of albumin, may contain blood and casts.	Urine may be turbid. Large number of pus cells, occasional red blood-cells, albumin.	 Urine
Greatly increased capacity of renal pelvis may be measured. Radiographic examination may demonstrate stone in pelvis and pyelography may show etiologic factor.	Normal findings, excluding type of urinary secretion.	Quantities of pus observed escaping from one or both ureters; secondary bladder involvement. Radiographic examination negative.	..Cystoscopy and radiography

DIFFERENTIAL DIAGNOSIS OF LUMBAR PAIN

Symptom	Kidney Abscess	Perinephritic Abscess
Age	Any.	Any.
Onset	Usually sudden, following septic infarct or penetrating wounds.	Rather sudden; early symptoms may be mild and indefinite.
Subjective signs and symptoms	Pain: As a rule, severe, in lumbar region. Temperature: high, usually accompanied with chills.	Pain: In early stage vague, in lumbar region, and usually referred to an upper abdominal quadrant or loin. Gradually becomes more severe as process extends. Temperature may be high, irregular, with chills.
Objective signs	Rigidity and tenderness usually marked in kidney region, especially in costovertebral angle. As a rule kidney is enlarged and swollen. Usually no mass, but one may be present.	Tenderness and rigidity over abdominal and lumbar muscles of the affected side. Worse on pressure or movement. Posture often affected. Increased fullness of loin or definite mass over affected kidney. In advanced cases signs of inflammation such as redness, and fluctuation.
Urine	May be decreased output. Severe pyuria.	Usually normal and free from pus. If pus present, kidney involved.
Cystoscopy and radiography...	Urine loaded with pus, coming from ureter of affected side. Both kidneys may be involved. Radiogram may show enlarged kidney.	Cystoscopy generally negative. Radiogram may show cloudiness around kidney where abscess extends.

DUE TO KIDNEY AFFECTIONS (*Continued*)

Renal Infarction	Hypernephroma	Polycystic Disease
Any.	Any. Usually in young adult or adult life.	Any. Often latent until middle life.
Very sudden.	May be very insidious.	Slow. Diagnosis may be one of a chronic nephritis for years.
Pain: Sudden and stabbing, radiating to lumbar region or central part of abdomen; anywhere; not paroxysmal and not as a rule radiating to genitalia. Temperature elevated if infarct becomes infected.	May be entirely absent, or there may be a dull constant ache, or acute paroxysms of pain, radiating to flank and genitalia. Tenderness is usually present, may be marked over costovertebral angle. Progressive emaciation. Death.	May be present for years without pain; then dull, persistent pain in lower back and loins with occasional attacks of renal colic.
May have rigidity over entire abdomen and lumbar region. Usually marked tenderness and rigidity in costovertebral angle. No mass.	Tumor may not be demonstrable or it may be so large as to fill greater part of abdomen. Often precocious development of genitalia.	In early cases, mass is not recognizable. Well developed case presents large tumor, elongated, hard, nodular, irregular, moving on respiration, in lumbar region.
Entire cessation or great diminution of urine passed. Blood always present. If infected, pus and bacteria.	Hematuria is usually present.	Polyuria, low specific gravity. May have some albumin, few hyalin casts and few red blood-cells.
Will show anuria or lessened output from affected kidney. Radiogram negative.	Cystoscopy usually negative. May show indefinite tumor mass, with intestines pushed to one side. X-ray.	Find residual urine in pelvis. Pyelography shows enlarged, elongated pelvis and calices, irregular, in greatly enlarged kidney.

DIFFERENTIAL DIAGNOSIS OF PAIN IN THE BACK DUE TO MUSCLE, BONE OR JOINT DERANGEMENT

Symptom	Lumbago	Spondylitis Deformans	Tuberculosis of Spine	"Typhoid Spine"
Age	Adults.	Any. Usually after 40.	Any. Especially 4-20.	Any.
Onset	Sudden. Follows a forceful straightening of body when flexed as in lifting a heavy weight. May follow prolonged exertion with fatigue.	Slow, mild and progressive. Often occurs in people of sedentary habits.	Gradual; may be history of injury to spine several months previously. General weakness, fatigue, loss of weight and sleeplessness. One of early symptoms may be the supporting of body upon chair or table.	Rapid, late in course of, or after typhoid fever.
Pain: type and radiation	Acute, severe in lumbar region on one or both sides. Increased on stooping or on straightening body from flexed position.	Pain locally over spine more severe in lumbar region and on motion. Radiates along nerves passing between affected vertebrae.	May be entirely absent; usually constant but seldom severe. Referred to area supplied by nerve roots affected. Increased by local pressure, movements or jars. Sudden increase of, may mean beginning of abscess or paralysis.	May be acute pain on motion or dull ache during rest. May radiate to back, abdomen or both thighs. Often very severe over involved area.
Temperature ...	Normal.	Normal.	Evening elevation.	May be present with a transient rise.
Tenderness	Marked, of lumbar muscles.	As a rule none; may be very slight, in an acute case.	May find tender spot on spinous process, usually lacking, even when large cold abscess is present. In acute cases may be very pronounced.	Definite over one or more vertebrae.

Rigidity	Pseudo-rigidity because of involved muscles.	Limitation of motion of spinal muscles due to ankylosis, adhesions or exostoses of vertebrae. At times there is complete immobility.	Present early and is persistent. This is a very valuable sign. Spine is held stiff and rigid when walking, when arising or when picking objects from floor.	Muscles of back are held rigid.
Mass or deformity	No.	Kyphosis with uniform curve, at times there is atrophy of spinal muscles.	May be abscess formation, either retro-pharyngeal, dorsal, lumbar or psoas. When fairly well advanced, characteristic angular kyphosis.	Kyphosis or scoliosis may develop.
X-ray	Negative.	Shows exostoses, ankylosis, and atrophy of intervertebral discs.	In early cases, negative. Later shows degeneration of vertebral body.	Negative.
Blood	Normal.	Normal.	May be slight leukocytosis, or may be a pronounced increase of the white cells when abscess is secondarily invaded by a pyogenic organism.	Normal at first; positive Widal reaction later on.
Special data ...	Patient walks with slow gait and rigid back. Recurrence common.	Ribs may become flexed, thorax immobile, causing abdominal breathing. A steadily progressive disease.	All motions of body are made carefully and slowly to avoid pain. A chronic bilateral pain in the trunk or extremities is suggestive of Pott's disease (DeCosta). Paralysis from pressure on cord or pachymeningitis may develop. Tuberculin reaction is usually positive.	May be associated with hysteria; reflexes may be disturbed. Cramps in legs common.

DIFFERENTIAL DIAGNOSIS OF PAIN IN THE BACK DUE TO MUSCLE, BONE OR JOINT DERANGEMENT (*Continued*)

Symptom	Acute Osteomyelitis of Spine	Fractures of Vertebrae	Sacro-iliac Strain	Lumbo-sacral Strain	Tumors of Spine
Age	75 per cent under 20.	Any.	Adults.	Adults.	Usually after 30.
Onset	Acute, often follows slight trauma. At first there are symptoms of generalized infection, becoming localized.	Sudden, follows injury, one or more vertebrae in cervical or dorsal region usually affected. May be accompanied with shock.	Sudden, follows a severe strain upon the joint. With pregnancy, onset is gradual in late months.	Sudden, usually a part of sacro-iliac strain.	Gradual and progressive. Often accompanied with pain in the early stages.
Pain: type and radiation	First generalized body pains, becoming localized over involved area.	Localized to point of fracture, increased on motion or pressure. May be referred along nerves involved.	Directly over joint. Referred along course of sciatic nerve, worse at night. May be brought on by raising leg while knee is held rigid. Often most marked on change of position in bed.	Referred to anterolateral and posterior aspects of leg. Increased by lifting or working in a bent over position.	May be absent. At times marked over distribution of nerve roots involved.
Temperature ..	High elevation.	Normal.	Normal.	Normal.	Normal.
Tenderness	Localized to area involved.	Localized to area involved.	Definite over sacro-iliac joint, one or both sides and in sacro-iliac notch.	Tenderness over ilio-lumbar ligaments.	Usually not present, unless secondary neuritis is present.
Rigidity	Always present and usually marked.	Spine held rigid, because of severe pain at point of fracture.	Marked on all bending motions. When standing there is tendency to lean trunk away from affected side.	Lumbar spine held rigid. Patient flexes knees when he bends backwards.	As a rule not present.

Mass or deformity	Local swelling over spine, after three to ten days. After one to three weeks, abscess may form anteriorly or posteriorly.	May have local swelling over point of fracture, obliterating deformity. Concavity of cervical or lumbar region may be obliterated. Kyphosis may be present. Partial reduction before examination will have decreased deformity.	Scoliosis may develop from posture assumed, for the relief of pain.	Postural abnormalities may develop in later stages.	Depends upon extent of lesion.
X-ray	After the first few days rarefaction of vertebrae becomes visible with gradual formation of sequestrum.	Shows point of fracture, crushing together of bodies, separation of arches or spinous processes, encroachment on cord.	May show separation of joint.	Rarely shows separation of joint.	May show evidences of pressure necrosis or definite degenerative changes of bone.
Blood	High leukocytosis.	Normal.	Normal.	Normal.	Normal or slight leukocytosis.
Special data ..	41 per cent occur in lumbar region and it is the least common in cervical region. Staphylococcus is usually the causative organism. If bodies are affected, abscess will be prevertebral, retropharyngeal, in the mediastinum or psoas. The infection often extends to meninges and cord.	Danger is in injury to cord with early flaccid paralysis below level of lesion, sensory paralysis, disturbance or abolition of reflexes, retention, later incontinence of urine and feces.	Walk with short steps, tendency to keep weight off affected side. Cannot be comfortable for any length of time when lying on side involved. Pelvic compression is painful.	Can be made comfortable on either side or back.	Neurologic signs and symptoms aid in localization.

CHAPTER VIII

THE FEMALE GENITAL ORGANS

AFFECTIONS OF THE FEMALE GENITAL ORGANS

Ovaries	{	congenital malformations	{	absence of one or both ovaries
			{	fetal development
			{	displacements
		injuries		
		inflammations (ovaritis)	{	acute { exudative
				{ interstitial
			{	chronic
		hemorrhage	{	into graafian follicle (follicular hemorrhage)
			{	into stroma of ovary (ovarian apoplexy)
		pregnancy		
		prolapse	{	primary
			{	secondary
		hernia or ovariocele		
		hydrocele		
Ovaries	{	granulomata	{	tuberculosis
			{	actinomycosis
		solid tumors	{	benign {
				fibroma
				adenoma
				myoma
				leiomyoma
				chondroma
				papilloma
				lymphadenoma
				teratoma
			{	malignant {
				teratoma
				carcinoma
				sarcoma
Ovaries	{	cysts	{	follicular (dropsical graafian follicle)
				of corpus luteum
				glandular
				dermoid
				papillary
				hemorrhagic ("chocolate")
		complications of cysts	{	inflammation
				hemorrhage
				twisting of pedicle
				rupture
				adhesions

Broad ligaments	cysts	parovarian	{	pedunculated sessile	{	inflammation hemorrhage axial rotation rupture adhesions		
		of Kobelt's tubules						
		of vertical and transverse tubules						
		parovarian varicocele						
Ovarian ligaments	tumors	benign	{	fibroma lipoma				
	malignant	{	carcinoma sarcoma					
Round ligaments	tumors	fibroma	{	intraperitoneal extraperitoneal				
	carcinoma sarcoma							
Suppuration of pelvic connective tissue	{	primary	{	secondary to	{	tuboövarian disease laceration of perineum or cervix septic endometritis tears of lateral culdesac suppurating hematoceles of broad ligament pelvic hematocele ulceration following poorly fitting pessary rectum, bladder, appendix		
Echinococcus disease of pelvis								
Fallopian tubes	{	malformations						
		inflammations (salpingitis)	{	acute chronic (adherent or interstitial)	{	pyosalpinx hydrosalpinx hematosalpinx		
	tumors	benign						
		{	fibroma papilloma lipoma myxoma cysts					
		malignant	{	carcinoma sarcoma				
			tubal pregnancy					
Uterus	{	malformations	{	absence rudimentary fetal infantile septate bilobularis one-horned two-horned double uterus				

Uterus (<i>cont.</i>)	{	injuries	{	external violence
			{	foreign bodies
			{	parturition
		displacements	{	anteversion
			{	anteflexion
			{	retroversion
			{	retroflexion
		prolapse	{	acute
			{	chronic
		inversion		
		tumors	{	fibroma
				fibromyoma
				myoma {
				submucous
				intramural
				subserous
				rhabdomyoma (in cervix)
				angioma
				adenoma
				endothelioma
		malignant	{	carcinoma {
				body, adenocarcinoma
				cervix, squamous-cell carcinoma
				sarcoma {
				arising in parenchyma
				arising in endometrium
				chorio-epithelioma
				hydatidiform mole ((benign or malignant))
		inflammations	{	metritis and endometritis {
				congestive
				constitutional
				gonorrheal
				septic
				tuberculous
				endocervicitis
		hematometra		
		subinvolution of uterus or myofibrosis		
		superinvolution		
		hernia of uterus		
		hypertrophy of endometrium		
		laceration of cervix		
		hypertrophy of cervix		
		polypi of cervix	{	mucous
				fibroid
				papillary
		eversion of intracervical mucosa		
		atresia and stenosis of cervix	{	congenital
				acquired
		chancre of cervix		

Vagina	{	malformations	{	double		
			{	absence		
			{	stenosis		
	{	injuries	{	foreign bodies		
			{	tears		
	cystocele					
	rectocele					
	hernia					
	{	fistula	{	vesicovaginal		
			{	ureterovaginal		
			{	rectovaginal		
{	inflammation (vaginitis)	{	simple			
		{	gonorrheal			
		{	granular			
		{	senile			
		{	emphysematous			
{	cysts	{	retention			
		{	epithelial inclusion			
		{	hydatid			
		{	dermoid			
{	tumors	{	benign	{	fibromyoma	
			{	papilloma (polypus)		
		{	malignant	{	carcinoma	
			{	sarcoma		
hematocolpos						
Vulva	{	malformations	{	absence of whole or any part		
			{	infantile		
			{	hypertrophy of whole or any part		
			{	hermaphroditism		
	{	injuries	{	labor		
			{	direct violence		
	{	inflammations	{	simple catarrhal		
			{	gonorrheal		
			{	follicular		
	{	tumors	{	benign	{	fibroma
				{	myoma	
				{	myxoma	
				{	lipoma	
				{	neuroma	
				{	angioma	
			{	malignant	{	epithelioma
				{	sarcoma	
	syphilis					
	cysts					
kraurosis vulvæ						
elephantiasis						
varicose veins						
hydrocele of canal of Nuck						
pruritis vulvæ						
vaginismus						

AFFECTIONS OF THE OVARIES

Congenital Malformations

Congenital absence of both ovaries is a very uncommon condition, absence of one being more frequent. When one ovary is lacking there is usually associated an absence of the kidney and fallopian tube on the same side with other malformations of the genital tract. Faulty fetal development is more common than complete absence and may give rise to scanty or total lack of menstruation and to sterility. Displacement may occur anywhere in the pelvic or abdominal cavities; this condition is not infrequent, the organs commonly being present in a hernial protrusion.

Injuries

Isolated injuries to the ovary practically never occur but it may be lacerated, contused or separated from its blood supply during pelvic operations. Unless the function of both ovaries is completely disturbed, symptoms will probably not be evident.

Inflammations

Inflammations of the ovary may be acute, exudative or interstitial, or of a chronic type. The former is an extension of a septic or gonorrheal infection from lower down in the genital tract; rarely an involvement by the blood stream or lymph-channels has occurred. The inner structure of the ovary may be infected (oöphoritis) or only the periphery (perioöphoritis). All the usual signs of inflammation are present, *i.e.*, engorgement with blood and dilatation of vessels, swelling, increase in temperature, pain and degeneration into pus. An *abscess* forms which may occupy a small part of the ovary or replace the entire tissue. The organ becomes adherent to the surrounding structures and the abscess may drain into the bladder, intestines or vagina. Symptoms are obscured by the primary underlying disease, but those arising chiefly from the infected ovaries are pain and tenderness in the iliac regions. The pain is often acute and stabbing, radiating to the thighs, back, bladder or rectum. Elevation of temperature and a rapid pulse are associated findings. In the less acute forms, particularly when associated with perioöphoritis, the pain is usually most severe a week or ten days prior to the menstrual period; in any case the pain is increased by pressure through the rectum or vagina. On palpation, tenderness and a fullness may be discovered in the region of the ovaries.

The interstitial type of ovarian inflammation is more properly an acute congestion brought about by a variety of conditions, *viz.*, mumps, pressure from any pelvic organ, excessive alcohol and coitus, displacement of the uterus and from pelvic tumors. There is no pus formation nor adhesions. The symptoms are clouded by the causative condition but refer especially to the iliac region with pain and tenderness, most marked a few days before menstruation.

Chronic inflammation of the ovary may follow an acute infection, or the exudative inflammatory variety may be chronic from the beginning. The chronic type is also caused by pressure from displaced or distended pelvic organs. Chronic pain

in the region of the ovaries, intensified at the menstrual period and by standing or walking, is the most troublesome symptom. Menorrhagia, metrorrhagia or amenorrhea are associated findings; sterility is a frequent complaint.

Hemorrhage

Hemorrhage of the ovary may be either into the graafian follicles (follicular) or into the stroma (ovarian apoplexy). The former is the most common; the main mass of the ovary is normal but the follicle may be distended to the size of an orange. The blood may be absorbed and the ovary return to normalcy, or a cyst may remain. Serious hemorrhage arising from a ruptured graafian follicle is almost impossible to correctly diagnose. Such a case is reported by H. Rotte (*Bull. Soc. d'obstét. et de gynéc.*, 1927, 16: 204-207) and abstracted in Lewis, *International Surgical Digest*, 1927, Volume 3, page 345. The patient, an unmarried girl of twenty-one, who had had irregular, painful menstrual periods with amenorrhea at several times and whose last period was twenty days previously with pain persisting up to the present illness, was seized with severe abdominal pain in the lower quadrants, most marked on the right side. There was no bleeding from the genital canal, pulse was irregular and temperature 100° F. She was operated upon for appendicitis but on passing through the peritoneum the abdominal cavity was found filled with about 800 c.c. of blood whose source was the right ovary. This organ and the right fallopian tube were removed and ectopic pregnancy suspected. But on careful microscopic examination no evidence of such a pregnancy was found. The hemorrhage had arisen in an ovarian cyst which was broken by the follicle of the last menstrual period.

Hemorrhage into the stroma of the ovary may be secondary to follicular hemorrhage or entirely independent. Many small extravasations of blood may be seen, or there may be only one large blood cavity, the contents of which are absorbed and a cyst wall remains. Most of these cases are now considered as due to rupture of cysts arising from transplanted endometrial tissue. Hemorrhage arising from the ovary is usually the result of an ectopic pregnancy, but true ovarian pregnancy has been reported in only a few cases. It is difficult to differentiate such a hemorrhage from that arising in a ruptured tubal pregnancy. A history of irregular menstruation with signs of an old pelvic inflammatory disease will be obtained. The onset, with sharp pains in the lower abdomen, shock, weak, thready pulse, pallor, low blood-pressure and fluctuant mass in the culdesac, is typical of hemorrhage from either the ovary or tube.

Pregnancy

Ovarian pregnancy has been recognized for many years and many cases have been reported but it seems that most of them were primary in the tube from which they had aborted into the ovary. True ovarian pregnancy has been reported in only a few cases. L. A. Sutton thoroughly discusses ovarian pregnancy with complete pathologic findings (*Am. J. Obst. & Gynec.*, 1924, 7: 1). According to this author the spermatozoön may enter a graafian follicle before the ovum has been discharged or it may enter an old ruptured follicle into which another fresh follicle ruptures. The gestation may occur in a graafian follicle or in tissue

of müllerian type; in the case reported by Sutton he was unable to find any structures in the wall of the ovarian hematoma suggesting that the pregnancy had arisen in a graafian follicle. Forty-seven other authentic cases were found in the literature; many others should probably be admitted but their reports lack sufficient data or microscopic examination. Sutton's case was a woman of twenty-seven who had been married five years without becoming pregnant. When admitted to the hospital, her chief complaint was pain in the abdomen, particularly on the right side, increasing in severity since its onset two and one half months before; there was also pain on urination and defecation, and a bloody leukorrheal discharge. For the past seven years she had had a persistent leukorrheal discharge with pain in the lower abdomen leading to a diagnosis of pelvic inflammatory disease. Five months previously the last normal menstrual period had occurred; after that the periods were irregular or missing, with nausea, vomiting and pain in the lower abdomen, more severe on urination and defecation, and at times so sharp as to require anodynes. Ten days before admission to the hospital a practically normal menstrual period had occurred but three days later the patient noticed a fullness and tenderness in the right side of her abdomen. Examination of the abdomen disclosed no distention or masses but there was generalized tenderness, most marked in the lower right quadrant. The cervix and uterus were normal in size and position; on the right side, partially filling the culdesac, was a doughy mass about the size of an orange which apparently had no connection with the uterus. The preoperative diagnosis was a right tubal pregnancy with an hematocele in the culdesac. At operation the culdesac was filled with a large mass involving the right ovary, surrounded by old blood and many blood-stained adhesions, but there was no free blood in the pelvic cavity. Microscopic examination disclosed an ovarian pregnancy of about six weeks' duration which had terminated two to three months before operation. "The tube on the side of the pregnancy was intact and free from any evidence of pregnancy, the hematoma enclosing the pregnancy occupied the position of the ovary, and the hematoma was attached to the uterus by the utero-ovarian ligament. Normal ovarian tissue was found in several places in the wall of the hematoma: chorionic villi were found forming a junction between the chorionic vesicle and the connective tissue lining the ovarian hematoma. A degenerated embryo was located within this gestation sac and müllerian tissue was found in several places in the lining of the wall of the ovarian hematoma." The author concluded that there are no symptoms or signs by which ovarian pregnancy can be accurately diagnosed, the findings being the same as for any other type of ectopic gestation.

Prolapse

Prolapse of the ovary probably receives more consideration in most textbooks than the condition deserves. All kinds of vague symptoms may be attributed to prolapse but the underlying cause is usually of a different pathology. Prolapse may be *primary* or *secondary*. The latter is the result of pressure of a displaced uterus, tube, pelvic tumor or adhesions from a peritonitis. The prolapse is simply a complication of a more serious pelvic disease. Primary prolapse is supposed to result from increased weight of the organ, especially that of subinvolution or chronic

ovaritis. Symptoms considered by some writers to be characteristic of this condition are pain situated in the iliac region or pelvis near the sacrum, radiating to the hips, lumbosacral region, rectum or down the thighs, increased on standing, walking, coitus, urination and defecation and at the menstrual period; menstruation is apt to be increased in amount and is painful; other complaints are nausea, vomiting, indigestion, headaches, and nervousness. Such a variety of symptoms cannot be explained by any conscientious practitioner as being due to primary prolapse of the ovary.

Hernia or Ovariocele

Hernia of the ovary is a rare condition which may be either congenital or acquired, much more frequently the latter. The ovary has been found in the sac of practically every type of hernia but is most common in the inguinal, femoral, ventral and umbilical. It has been reported in an obturator hernia and has even passed through the greater sacrosciatic foramen. Usually the ovary is accompanied by the fallopian tube, omentum, and at times by intestines to which it is adherent. Chronic inflammation, cystic degeneration or abscess may develop. In many cases there are no symptoms referable to the ovary; in a typical case the hernial protrusion becomes swollen and tender during the menstrual period and is then the seat of severe pain. If the ovary is inflamed, the tenderness and pain may persist continuously.

Hydrocele

Hydrocele of the ovary, according to Bland Sutton, "arises in a tunic of peritoneum that occasionally invests the ovary much in the same way that the tunica vaginalis clothes the testis." The tube, which is elongated and tortuous but is not the seat of any inflammatory change, opens by its abdominal ostium into a sac on the posterior surface of the broad ligament. The ovary projects as a small mass from the inner surface of the wall of the sac. The hydrocele is filled with a clear, straw-colored fluid. The condition must be differentiated from a tubo-ovarian cyst arising from gonorrheal infection in which there is an inflammation of the tube with an obliteration of its lumen, destruction of the fimbriæ and ovary, distention of the tube and formation of a false passage into the cyst. There are no characteristic symptoms of hydrocele of the ovary; the findings will be similar to those present in cystic tumors of the ovary.

Granulomata

Tuberculosis of the ovary is very rare and when present is associated with the same type of infection of the peritoneum or fallopian tubes. Symptoms will concern the more extensive infection and those arising from the ovary will not be sufficiently definite to lead to a correct diagnosis.

Actinomycosis.—Actinomycosis is never primary in the ovary but may involve this organ by extension from the fallopian tube or adherent intestines or appendix. Most of the cases have been reported in foreign literature and in all, the intestines were firmly adherent to the uterine appendages. Involvement of the ovary occurs by direct extension, and infiltration. The dense connective tissue reac-

tion may lead to a diagnosis of ovarian tumor, and, microscopically, tuberculosis may be imitated. The condition is exceedingly rare.

Solid Tumors

Solid tumors of the ovary are found in about 26 per cent of ovarian tumors before puberty; after that period they are fairly uncommon, representing only about 5 per cent of ovarian neoplasms. The exact nature of the tumor cannot be diagnosed at the bedside; it is enough to differentiate between benign and malignant forms.

Benign.—The most common types of benign tumors are *dermoids*, *fibroma*, *adenoma* and *myoma*. They remain stationary in size or grow very slowly, are freely movable, not adherent to the uterus and have the general outlines and position of the ovary. The patient may have no symptoms until the tumor becomes of large size, but she will usually complain of pain in the iliac region, more severe on standing or walking, and relieved by lying down. The menstrual period is commonly upset, there being an irregular, painful or profuse flow. If the tumor develops rapidly with marked ascites, a malignant growth, carcinoma or sarcoma is present. Other findings are edema of the feet and legs, cachexia and loss of weight and strength. The tumor is easily palpated by bimanual examination and nodular masses may be felt in the posterior culdesac.

Malignant.—Malignant ovarian tumors in children are fairly common. In 1906 the author reported such a tumor in a girl of thirteen years and collected sixty-six others under fifteen from the literature (*Albany M. Ann.*, 1906, 76:20). After studying the reports of malignant ovarian tumors, he found it impossible in an early case to distinguish clinically the benign cyst or tumor from a malignant growth. Both may develop slowly and without causing pain, as the latter seldom is present unless a twist of the pedicle or some other complication occurs. As the tumor grows, however, symptoms referable to a malignant growth may follow, such as emaciation and those arising from metastasis or implantation. The histories present little variation since the health of the individual, in the majority of cases, has been reported as "good" up to the third, fourth, fifth or sixth month before the detection of the new growth. In some instances there were present symptoms referable to an abdominal tumor such as tightness of the clothing, dyspnea and constipation; some complained of pain and a few others were examined on account of an associated bloody vaginal discharge. Symptoms of an acute abdominal condition arising from twisting of the pedicle or rupture of the tumor indicated the proper diagnosis in several instances. The author concluded that children of all ages are susceptible to the disease, although it occurs most frequently in children between ten and fourteen years. Adults are usually affected. All ovarian tumors should be regarded with suspicion because of the possibility of malignancy.

Cysts

Cysts of the ovary occur in a large number of varieties and at any age. In early life dermoid cysts are common; before ten and after fifty, malignancy is frequently encountered. Cysts are classified as to their origin from the oöphoron, the

outer or egg-bearing portion, or from the paroöphoron, the inner or medullary zone. The former include follicular cysts, those of the corpus luteum, glandular and dermoid cysts; the latter give rise to the papillary cysts.

Simple, follicular cysts are due to failure to rupture and subsequent distention of a graafian follicle. They are usually unilocular, pedunculated, thin-walled and moderate in size, usually smaller than a lemon. Enormous cysts have been reported. The contained fluid, thin, clear and serous, does not coagulate on exposure to air or heat.

Cysts of the corpus luteum are more common in domestic animals such as the cow, mare, or sow than in humans. They may develop in nulliparæ and therefore do not always arise from the corpus luteum of pregnancy. In size they seldom become larger than a cherry or walnut, are of a bright yellow color and the thick wall contains an albuminous fluid.

Glandular cysts are also known as *ovarian adenomata*, *multilocular ovarian cysts*, *myxoid cystoma* or *pseudomucinous cystadenoma*. They are probably congenital and are by far the most frequent of all ovarian tumors, solid or cystic. Most of them are found between twenty and fifty years of age. They usually vary in size from that of a cherry to a baseball, but large ones, filling nearly the whole abdomen, have been encountered. The tumor is nearly spherical with a smooth, shining white surface. They are usually unilateral, rarely pedunculated. Such cysts are always multilocular and filled with a more or less viscid, clear, straw-colored fluid which is coagulated by heat. The color and consistency of the fluid vary in several specimens.

Dermoid cysts are of frequent occurrence in the ovary, and are usually present at birth or manifest themselves at puberty. They resemble dermoid tumors elsewhere in the variety of contents, *i.e.*, skin, sebaceous glands, hair, teeth, bone and nerves.

Papillary cysts are congenital in origin, arising from the paroöphoron as remains of the wolffian body. They make up about 18 per cent of all ovarian cysts and are found most frequently between the ages of thirty and fifty years (J. T. Erdmann and H. V. Spaulding, in *Surg., Gynec. & Obst.*, Oct., 1921, p. 362). As a rule they are smaller and grow more slowly than the glandular variety. On the inner surface of the cyst wall are soft, friable, usually pedunculated vascular papillomata. There is no specific ovarian symptomatology, the subjective symptoms being referred to other organs while the objective symptoms are vague and often absent. Symptoms appear gradually and are due to pressure on the intestines and bladder, causing constipation, hemorrhoids, frequent urination, digestive disturbances, and pelvic and reflex pains. Menstrual disorders are usually present but not often sufficiently marked to aid materially in the diagnosis. Sterility is a common complaint. The abdominal swelling, if of any size, will be cystic with, perhaps, a fluid thrill, dull on percussion, smooth, movable and separate from the uterus.

Hemorrhagic or "*chocolate*" cysts have been thoroughly studied by J. A. Sampson (*Arch. Surg.*, 1921, 3: 245-323; *Am. J. Obst. & Gynec.*, 1922, 4: 451-512; *Boston M. & S. J.*, 1922, 186: 445-456). He concludes that perforating hemorrhagic cysts of the ovary occur most frequently between thirty and the menopause, and that nearly 10 per cent of cases require abdominal operation for relief of

pelvic disease. They are more common in women who have not borne children, and rare in those who have had salpingitis. The size of the cyst usually varies from 2 to 4 centimeters in diameter. Adhesions of the cyst or ovary are always present, and in freeing it, the old hemorrhagic or "chocolate" contents escape. The cysts are found anywhere in the pelvis, especially in the culdesac. The lining is an epithelium, of the endometrial type which undergoes changes during menstruation, as does the lining of the uterus. When a cyst ruptures, the "menstrual" blood and some epithelial tissue escape causing adhesions wherever they lodge between the peritoneal folds. They may be small and quiescent or active, in which latter case they give rise to "adenomyoma" of the uterosacral ligament, round ligament, rectovaginal septum, rectum, sigmoid or other pelvic structures. After the menopause the cysts retrogress and disappear, but the adhesions may persist and give rise to symptoms. Such symptoms are often pain, constipation or even those arising from a partial intestinal obstruction. The most characteristic physical sign is an adherent retroflexed or retroverted uterus with an area of induration behind the cervix, usually best detected by palpation through the rectum.

Complications.—The main complications which may arise from an ovarian cyst are *inflammation, hemorrhage, twisting of the pedicle, rupture and adhesions*. *Inflammation* may extend from any of the contiguous structures, *i.e.*, tubes, intestines, urinary bladder; formerly tapping was a frequent cause. The condition is common in dermoid tumors. Suppuration may occur with adhesions or rupture. Symptoms of acute suppuration in an ovarian cyst are sudden increase in size of the tumor, severe pain and marked tenderness over the cyst, high temperature, rapid pulse and loss of weight and strength. *Hemorrhage* arising from an ovarian cyst may be the result of a twisted pedicle, may arise from the friable papillary growths or may follow a blow or fall on the abdomen. If there is much loss of blood there will be shock, subnormal temperature, a weak, thready pulse, fluctuation in the culdesac and other usual signs of internal hemorrhage. *Twisting of the pedicle* gives rise to the most acute symptoms found in connection with ovarian cysts and is one of the important causes of an acute abdominal condition. It is not as frequent now as when these cysts were allowed to attain enormous size. The exact cause of the twisting is not known but the responsibility has been placed on the peristalsis of the intestines, size of pedicle, the contractile movements of the bladder and sudden motions of the patient. Twisting cannot occur if there are adhesions or if the cyst is too large. The symptoms will be acute, or slowly developing, depending upon the rapidity of the twisting of the pedicle. The acute symptoms are distinctive and consist of severe abdominal pains in the region of the cyst with nausea and vomiting, sudden enlargement of the cyst and, at times, signs of internal hemorrhage or beginning peritonitis. *Rupture* of an ovarian cyst is not uncommon and may result from overdistention, degeneration or trauma. The encysted fluid escapes into the abdominal cavity where a peritonitis may develop. The symptoms of rupture are sudden abdominal pain in the region of the cyst with disappearance or diminution in its size. Signs of free fluid will be found in the abdominal cavity; there may be a reaccumulation of fluid in the cyst. *Adhesions* about an ovarian cyst are common but give no characteristic symptoms. Adherence to the intestines does not appreciably limit motion of the cyst; adhesion to the pelvis can be determined by bimanual examination.

AFFECTIONS OF THE BROAD LIGAMENTS

Cysts

The most common affections of the broad ligaments are cysts developing from the parovarian, the remains of the wolffian body situated between the layers of the ligament. There may be cysts of *Kobelt's tubules* or of the vertical or transverse tubules, either *pedunculated* or *sessile*. They are all rare and without clinical significance except the sessile variety which may give symptoms resembling an ovarian cyst developing between the folds of the broad ligament. Such symptoms are pressure in the pelvis giving rise to constipation, hemorrhoids, bladder irritation, edema of the legs and reflex pains; menstrual disturbances such as menorrhagia, metrorrhagia or dysmenorrhea; there may be sterility from displacement of uterus and its tubes; the general health is seldom affected. On bimanual examination the cyst is found low down in the pelvis, between the layers of the broad ligament and pushing the uterus to one side. All of these cysts may have the same complications as those of the ovary; namely, inflammation, hemorrhage, axial rotation, rupture or adhesions.

Parovarian Varicocele

A varicocele of the parovarian veins is homologous to a varicocele of the spermatic veins but is much less common. The condition has been considered due to subinvolution or displacement of the uterus, and constipation. In most cases there are no symptoms but if the veins are greatly dilated the patient may complain of a dragging pain in the iliac region extending upward toward the kidney. In the recumbent posture the pain is relieved but it is more severe on standing, walking or riding. Bimanual examination will reveal a doughy mass in the broad ligament which decreases in size when the patient lies down. Diagnosis is not possible before operation, however, the presence of a tumor of the broad ligament or ovary usually being suspected.

Tumors

The tumors which have been reported in the broad ligament are fibroma, lipoma, carcinoma and sarcoma. All of these are very rare. The malignant types are secondary to the same condition in the uterus, ovary or peritoneum. Symptomatically they resemble ovarian tumors so that the diagnosis is not made before operation.

TUMORS OF OVARIAN LIGAMENTS

Tumors of the ovarian ligaments which have been described are fibroma, sarcoma and carcinoma. All of them are rare but the fibromata are the most frequently encountered, at times growing to the size of a cherry in cases in which the uterus is the seat of numerous fibroids. Because of their similarity to ovarian tumors and especially because of their small size they cannot be diagnosed before operation.

TUMORS OF ROUND LIGAMENTS

Tumors of the round ligaments are rare, *i.e.*, fibroma, carcinoma or sarcoma. Fibroids are not uncommon in cases where the uterus is affected by the same condition since this ligament is practically a process of the muscular tissue of the uterus; such tumors are intraperitoneal. They all develop slowly, are hard, often pedunculated and give no symptoms until of sufficient size to cause pressure. Such tumors of the broad ligaments together with adhesions, cysts, tumors of the uterus, tubes or ovaries or hydrosalpinx may, at times, be demonstrated by cystography after the bladder has been filled with 3.5 per cent solution of sodium iodid. Such conditions may cause visible pressure defects and irregularities in the contour of the bladder. This subject was recently discussed by S. A. Robins (*Am. J. Roentgenol. & Radium Therapy*, 1927, 18: 546).

SUPPURATION OF PELVIC CONNECTIVE TISSUE

Suppuration of the pelvic connective tissue is very rarely primary but is usually due to tubo-ovarian disease, lacerations of perineum, cervix or into the lateral culdesac, septic endometritis, suppuration of pelvic or broad ligament, hematoma or infection of the rectum, bladder or appendix. If suppuration occurs, pus is found most commonly in the broad ligaments or in the connective tissue anterior or posterior to the uterus. The pus may burrow along the line of least resistance and open into the bladder, intestines, peritoneum or vagina, into the labium majus or perineum or through the saphenous, sacrosciatic or obturator foramen. Symptoms are not characteristic but simulate those of tubo-ovarian disease and the underlying condition. The main complaint is pain low down in the abdomen and pelvis; there are also present a rise in temperature, at times weak, thready pulse; chills, loss of appetite and prostration. Involvement of the bladder and rectum will cause painful urination and defecation. Bimanual examination will disclose extreme tenderness and a mass, if suppuration has occurred.

ECHINOCOCCUS DISEASE OF THE PELVIS

Infection by the *Tania echinococcus* is very rare in the United States, not common in Asia or Africa but is frequently found in Australia. Entrance to the body is gained by the gastro-intestinal tract or the vagina. The resulting hydatid cysts are situated in the connective tissue near the rectum from where they may extend upward to the abdomen, downward to the perineum or through any of the lower pelvic foramina. For some time the general health is not interfered with nor are there any definite symptoms. As the cysts increase in size they cause pressure symptoms on the sciatic nerve, bladder, ureters and rectum and great vessels; edema of the legs may be present. There is progressive loss of weight and strength.

AFFECTIONS OF THE FALLOPIAN TUBES

Malformations

Malformations of the fallopian tubes are not common. There may be complete absence of both tubes, more frequently of one, associated with unicornate uterus

and absence of the ovary on the same side. Rudimentary tubes consisting of small fibrous cords without a lumen are thought to be due to fetal peritonitis. Accessory tubes or accessory ostia are not uncommon. Displacements and distortions of many varieties are found and are conducive to ectopic pregnancies.

Inflammations

(*Salpingitis*)

Inflammation of the fallopian tubes is a common disease, due to extension of infection from the uterus and rarely from the appendix and peritoneum. The most frequent causes are gonorrheal and septic infections, the former by far outnumbering the latter; 50 per cent of cases of gonorrheal endometritis have an extension to the tubes. *Tuberculous salpingitis* is an extension from the peritoneum, possibly from the uterus or blood stream. The severity of the infection will depend upon the virulence of the organisms and the resistance of the patient; symptoms may be acute or chronic.

In *acute salpingitis* the tube quickly becomes swollen and friable with the lumen distended with pus and the fimbriated end closed. Death may result from sepsis or general peritonitis or the inflammation may subside, become chronic or disappear. Symptoms will depend upon the severity of the infection. Pain is a constant complaint, being either severe or dull and heavy, with tenderness in the lower abdomen and pelvis, worse on standing or after evacuation of the bladder or bowels; painful, frequent, prolonged menstrual periods are the rule. General symptoms include fever, debility, loss of weight and gastro-intestinal disturbances. All symptoms are more severe at the time of the menses.

Chronic salpingitis usually does as much damage to the tubes as does the acute type but the process is more gradual. The tube becomes filled with pus which for a time may be discharged through the uterine cavity. When both ends of the tube are closed, the cavity becomes distended with pus, serum or blood, and is then termed *pyosalpinx*, *hydrosalpinx* or *hematosalpinx*. The results of such an infection may be adhesions, local or general peritonitis, general sepsis, abscesses or fistulous openings. The symptoms are similar to those found in the acute variety but are less severe. Dull pain in the lower abdomen and pelvis, made worse by standing and at the time of the menstrual period, is the chief complaint. The pain is also increased by evacuation of the bladder or bowels but as the disease becomes more chronic the pain tends to lessen. The menstrual flow usually appears a few days earlier than normally and lasts a few days longer. The general health is affected, the patient often being run down and underweight. Sterility is a common complaint. Fixity of the uterus is found on vaginal examination.

Pyosalpinx is the term used to describe a fallopian tube distended with pus. The condition is usually the result of a chronic gonorrheal infection but in old cases the pus tends to become sterile. The tube is swollen to many times its normal size and densely adherent to surrounding structures. Symptoms will be similar to those of chronic salpingitis.

A *hydrosalpinx* is a fallopian tube distended with serum but otherwise similar to a *pyosalpinx*. It may result from the same causes, the pus being absorbed and only serum remaining. If rupture occurs the fluid is rapidly absorbed. Torsion of

a hydrosalpinx occasionally occurs and gives rise to signs and symptoms similar to those produced by the twisting of the pedicle of an ovarian cyst but not so severe. This subject, with a complete review of the literature, was recently discussed by N. J. Eastman (*Surg., Gynec. & Obst.*, 1927, 45:143).

A *hematosalpinx* is similar to a pyosalpinx except that the cyst contains blood instead of pus. It is an unusual condition and results from rupture of a tubal pregnancy or bleeding into a pyosalpinx or hydrosalpinx. Such a tube may become reinfected and be connected with a pyosalpinx presenting the symptoms of an acute purulent salpingitis.

Tumors

New growths of the fallopian tubes are rare but fibroma, papilloma, lipoma, sarcoma and carcinoma have been reported. The malignant forms are metastatic; the benign forms are usually of small size and give few physical signs or symptoms. Examination shows a tumor in the region of the tube but the exact diagnosis cannot be made before operation.

Tubal Pregnancy

A pregnancy occurring in the fallopian tube follows any obstruction to the normal descent of the ovum. Chronic salpingitis, usually the result of gonorrheal infection, is by far the most frequent cause. Others are peritoneal adhesions, diverticula, or congenital malformations. M. G. Cotte considers that alterations in the normal peristalsis of the tube play an important part in ectopic pregnancies (*Bull. Soc. d'obst. et de gynec.*, 1927, 16:298). Hirschberg and Pinzsohn have demonstrated tubal peristalsis in the human. The patient generally gives a history of having had children, but several years have elapsed since the last pregnancy. When the fetus develops to sufficient size, or deeply invades the tubal wall, a rupture results. This occurs most frequently from the eighth to the twelfth week, and gives rise to a very severe attack of pain in the lower abdominal quadrant on the affected side. There will be severe shock and possibly death in a few hours from profuse hemorrhage. If the rupture occurs in the lower portion of the tube, the blood may escape between the layers of the broad ligament, where the pressure soon prevents such a sudden loss as into the abdominal cavity. Vaginal bleeding, usually small in amount, often precedes the acute symptoms. Very exceptionally tubal pregnancies go to full term. (See Differential Chart, "Acute Abdominal Pain with Shock.")

Tubal Patency Tests.—The fallopian tubes have been examined for patency in many ways. Originally, microscopic examination was used; then insufflation with carbon dioxid, and later injection of sodium bromid, followed by a radiogram. The two methods which recently have gained favor because of their simplicity and fewer dangers are insufflation with carbon dioxid and the injection with iodinated oil and the taking of a radiogram.

Peruterine insufflation of the tubes has been widely used in recent years. I. C. Rubin gives a good description of the procedure (*Am. J. Surg.*, July, 1926, pp. 1-13). By a careful gauging of the carbon dioxid released, the point at which the gas escapes from the tubes into the peritoneal cavity can be determined by a sudden drop in pressure. If the tubes are closed this drop is not present, but the pressure

of the gas rises to as high as 200 millimeters, twice as high as when the tubes are patent. Over 200 millimeters of pressure should never be used. The patient is then fluoroscoped in a standing position; if the gas has escaped into the peritoneal cavity it may be visualized under the diaphragm on one or both sides. In such a case pain in one or both shoulders is the chief complaint. If the tubes are closed, pain is complained of in the lower abdomen on the side of the obstruction. It may be necessary to repeat the examination at a later period or to make a radiogram of the distended tube to rule out spasm.

Insufflation should never be used in the presence of any pelvic inflammation, menstruation or serious cardiac or renal disease.

The fallopian tubes are also tested for patency by the injection of iodized oil. Such a procedure is completely described by L. S. Newell (*Am. J. Obst. & Gynec.*, 1926, 12: 189-199). Under sterile precautions the uterine cavity is probed to determine its size and then lipiodol or iodipin is injected until pressure is necessary. An immediate radiogram will demonstrate the exact size and shape of the uterus and any obstruction in the tubes. By this means the following conditions can be diagnosed: Chronic subinvolution, encroachment on the uterus by a carcinoma or fibroid, foreign body inside or outside the uterus, pressure of tumors or cysts of ovary, the differentiation of the uterus from other masses and the exact location of tubal obstruction.

AFFECTIONS OF THE UTERUS

Malformations

Malformations of the uterus are fairly frequent, of a great variety and usually due to incomplete fusion of the müllerian ducts. Complete *absence* is rare and in most cases it is associated with malformations of other portions of the genital tract. The ovaries may or may not be absent since they have an independent origin. The uterus may be represented as a *rudimentary body* on the posterior surface of the bladder or by two vertical fibrous cords. This organ frequently retains its *fetal* or infantile form, never progresses to full development and is therefore functionless. In such a case the cervix makes up two-thirds of the uterus instead of the normal one-third. The most frequent malformation is an *intra-uterine* septum dividing the cavity into two portions, usually unequal in size and extending a variable distance from the fundus to the external os. There may be two lobes attached to a single cervix, a uterus *bilobularis*, or two cornua attached to a single cervix, a uterus *bicornis*, or again two separate organs each with one tube and ovary, a uterus *didelphys*. A müllerian canal may fail to develop, producing a *one-horned* anomaly. The chief importance of all these malformations is their effect on sterility and pregnancy.

Injuries

Injuries to the uterus rarely result from external violence, but stabbing, shooting or gouging by the horns of an animal may traumatize this organ. More frequently the injury is due to direct, internal violence from a foreign body, curettage or parturition. Normally the uterine wall is fairly firm and resistant but during pregnancy, malignant degeneration or septic infection, the musculature becomes

soft and friable and is easily injured. Hence attempts to produce abortion with sounds, bougies or even curets are liable to rupture or perforate the uterus. The organ is occasionally ruptured during labor when a cervical or pelvic obstruction prevents the strong uterine contractions from delivering the fetus in the normal manner. Diagnosis of severe injury to the uterus from external violence is seldom made before operation, because the general and local signs and symptoms are similar to those of injury to other pelvic viscera. When the uterus is ruptured during operative or criminal procedures the instrument is felt to slip in beyond the normal limit of the uterine cavity and the end may be palpated through the abdominal wall. Usually sepsis and a generalized peritonitis occur, with chills, high temperature, rapid pulse, low abdominal pains and a foul, purulent uterine discharge. The patient usually dies.

Displacements

Displacements of the uterus from its normal position of anteversion and slight anteflexion are common. Increase in the forward positions, *anteversion* and *anteflexion*, are caused by tumors posteriorly, an enterocele, abscess in the pouch of Douglas, fibroid tumors or any force pushing from behind. The chief symptoms of this type are dysuria, polyuria and other evidences of bladder irritation; dysmenorrhea and sterility may be present in a severe case. Posterior displacements are more common and give rise to more troublesome symptoms than the anterior ones. They occur especially in parous women and result from laceration and relaxation of the pelvic floor due to labor, overdistention of the bladder or rectum and subinvolution of the uterus. Symptoms of *retroversion* and *retroflexion* are a dull ache in the lumbosacral region, a feeling of weight and bearing-down in the pelvis, irritability of the rectum with possibly hemorrhoids, leukorrhea, menorrhagia and, at times, sterility or abortion. Vague intestinal disturbances and neurasthenia are often present.

Prolapse

Prolapse of the uterus is a sinking of that organ below its normal level in the pelvis. It may be of any degree; when it passes the vaginal opening it is termed complete. *Cystocele* and *rectocele* are associated findings in severe cases. Such a condition may be due to weakened ligaments following labor, tumor or sudden, severe, muscular strain. Symptoms depend upon the acuteness of the condition. An acute prolapse is accompanied by shock, severe pelvic pain and sensation of something suddenly tearing away. A chronic case gives rise to a dull ache in the lower back, worse when standing, a feeling of weight and pressure in the pelvis, constipation, hemorrhoids, retention of urine, menorrhagia and leukorrhea. Upon bimanual examination the exact condition is readily diagnosed.

Inversion

An inversion of the uterus is a turning of that organ inside out, being either incomplete with a variable amount of depression of the fundus or complete when the uterus has passed through the cervical opening. The condition is rare but

may result from an active attempt on the part of the uterus to expel any material within its cavity or from traction on any substance attached to the fundus. Specific examples of the first cause are fundal attachment of the placenta with a short cord, adherent placenta, delivery in the erect posture, injudicious pressure over the uterine fundus and attempts to give birth to intra-uterine fibroids or polypi. The second cause is brought about by the pulling on an adherent placenta, polypus or submucous fibroid. The symptoms depend upon the acuteness of the condition. In a recent, rapidly developing case there is severe pelvic pain, shock and a large amount of uterine hemorrhage, if the placenta becomes detached. In a chronic case there is a bearing-down, dragging, heavy sensation in the pelvis, lumbosacral pain, leukorrhea, some hemorrhage and pressure upon the rectum and bladder. Upon vaginal examination there is found a soft, pear-shaped tumor constricted above at the cervix and covered with uterine mucosa.

Tumors

Benign tumors of the uterus are fairly common. Many forms have been found, including fibroma, myoma, rhabdomyoma, angioma, adenoma and endothelioma. The myomata are by far the most numerous. They are also called *fibromyoma* or fibroid tumors. Thirty-three per cent of women over thirty-five years of age have uterine myoma, but in most cases no symptoms result (Sampson). They are more frequent in single or sterile women than in those who have borne children. Most of the tumors are the size of small walnuts, but enormous ones of fifty or more pounds have been reported. They are rare before thirty and retrogress after the menopause. Three positions are possible for these myomata, *i.e.*, subserous or subperitoneal, intramural and submucous. The *subserous* variety grows out into the pelvic or abdominal cavity where there is less resistance; it may attach itself to any structure it can reach and become parasitic. The *intramural* type tends to become either one of the other two. The *submucous* form grows inward and closely simulates a pregnancy; the tumor may even be protruded through the vagina and be "born." As a rule these tumors are multiple and each type may be present in the same uterus. They may become edematous, liquefied, calcareous, cystic or malignant. Usually there are no symptoms unless the tumor is of large size, when pressure effects are noted. Then there may be irritability of the bladder or rectum, abortion and difficulty or impossibility of delivering a full term fetus or placenta. In the submucous variety especially, from pressure on the uterine mucosa, there may be a prolonged, profuse menstrual flow. In cases in which a fibroma complicates pregnancy, R. Ueros (*Rev. médico-quir.*, 1927, 2:499) states that 30 per cent abort, the maternal mortality is 50 per cent and fetal mortality 57 to 66 per cent. Fibroids cause fetal malpositions and early rupture of the membranes with premature delivery, dry labor, uterine inertia and mechanical dystocia. These tumors increase the necessity of operative interference and the dangers of postpartum hemorrhage (*J. O. Polak, Surg., Gynec. & Obst.*, 1928, 46:21).

Malignant tumors of the uterus may be carcinoma, sarcoma or chorio-epithelioma. They make up over one-third of all the malignant tumors of the body which explains why twice as many women as men die of cancer.

Carcinomata of the uterus are divided into those arising in the body and

those in the cervix; the former always occur as adenocarcinoma, the latter usually as squamous cell but rarely as adenocarcinoma. These tumors are found most frequently between fifty and sixty years of age and are rare before thirty. Those of the body are more likely to develop in women who have not borne children. The growth begins as a small nodule in the mucous membrane of any part of the cavity. The growth extends, may become more or less pedunculated and resemble a benign mucous polypus but is more friable, less smooth and more prone to hemorrhage. The growth tends to fill the uterine cavity and to distend that organ. The uterine wall is invaded early and extension occurs directly or by the lymph-channels to the aortic nodes. The disease progresses less rapidly than carcinoma of the cervix but is most active in a young person, especially when associated with pregnancy. Symptoms of carcinoma of the body are bleeding, offensive discharge and pain, but as J. O. Polak (*Am. J. Obst. & Gynec.*, 1928, 15:26) has pointed out, bleeding does not occur until there has been tissue necrosis and therefore only when the disease is well advanced. It is, however, *bleeding* which usually brings the patient to the doctor; after the climacteric it is a danger signal. The blood loss may be very slight, only appearing after straining at stool, exertion or coition. As the condition advances the bleeding increases and a watery discharge with a characteristic foul odor appears. Anemia and cachexia increase but pain is a late symptom found with extension to the bladder and rectum. Bimanual examination will reveal an enlarged, boggy uterus which bleeds readily when examined and from which there escapes a foul, watery discharge. A small portion of tissue may be obtained for microscopic examination but in a well-advanced case such a procedure is unnecessary.

Carcinoma of the cervix occurs as a squamous-cell variety or as an adenocarcinoma arising from the glands. Malignancy is ten times as frequent in the cervix as in the body and occurs most frequently in women who have borne children. Therefore chronic irritation and injury seem to be predisposing factors but the exact cause is unknown. The disease begins as a nodule, in the cervical canal or cervical glands, on the anterior or posterior lip and often at the site of an old laceration. The growth may become of an everting, cauliflower, or an inverting, nodular type. Progression occurs toward the vagina and about the bladder, ureters and rectum. Symptoms are similar to those in carcinoma of the body, *i.e.*, bleeding, foul discharge, pain, anemia and cachexia, but are usually discovered earlier. Bleeding is the most important finding and when occurring between menstrual periods or after the menopause should be viewed with alarm. It may be brought on by trauma such as straining at stool, douche, digital examination or sexual intercourse. A foul, characteristic odor appears while anemia and cachexia increase. In many cases the malignant area on the cervix can be seen but in all doubtful cases a specimen of tissue should be obtained by curettage for microscopic examination. Patients rarely live over three years and most of them die one to two years after the disease has manifested itself. The usual causes of death are uremia and exhaustion, rarely sudden hemorrhage, peritonitis, pulmonary embolism or septicemia.

Sarcoma of the uterus is a rare condition, occurring primarily in the stroma of the endometrium, in the parenchyma (wall), in a preëxisting leiomyoma or secondarily by extension from the ovaries. The sarcomata arising in fibroids are the most frequent and appear as multiple nodules which are not encapsulated but

extend and tend to break down. Those tumors arising from the endometrium usually begin in the fundus and soon involve the whole surface or form a pedunculated mass which may be mistaken for a benign polypus. They do not give rise to the expected signs of malignancy, bleeding and foul discharge, unless the endometrium becomes ulcerated. The diagnosis is frequently not made until the suspected benign specimen is examined microscopically.

A chorio-epithelioma of the uterus may or may not arise from an hydatidiform mole which is the result of disease of the chorionic villi in early pregnancy. Repeated bleeding occurs after pregnancy has been ended by abortion, premature or full-term delivery. The hemorrhage increases in amount until the patient is weak and anemic. By curettage of the uterus there is obtained tissue resembling placenta; this is necrotic, friable, very vascular and having a foul odor. Metastasis takes place through the blood-vessels to the liver and lungs. These growths are markedly malignant and have a very bad prognosis.

Inflammations

Inflammations of the uterus and its mucosal lining may be simple, congestive, gonorrheal, septic or tuberculous. The simple variety is due to congestion caused by displacements, tumors, subinvolution, constipation, stenosis of cervical canal and several other pelvic disorders. Symptoms arise insidiously and are chiefly of leukorrheal and mild menstrual upsets. The same symptoms are frequently encountered in general constitutional disturbances such as tuberculosis, anemia, gout, rheumatism and chlorosis.

Gonorrheal endometritis is always the result of an extension from an endocervicitis, just as gonorrheal infection of the fallopian tubes follows involvement of the uterus. The condition may be acute, with chills, high temperature and rapid pulse, vomiting, diarrhea, tenesmus and purulent vaginal discharge. The chronic form may come on so slowly that the simple, congestive type of endometritis is simulated. Often the symptoms of inflammation of the tubes and localized peritonitis overshadow the disease in the uterus. The uterus is swollen, soft and tender. A microscopic examination of the discharge will often show the causative organism. Associated inflammation of the tubes, Skene's glands, the urethra and the vulvo-vaginal glands aids in the diagnosis of gonorrheal endometritis.

Septic endometritis follows introduction of any unsterile matter into the uterus and hence a large number of cases follow labor and abortion. The onset is usually acute within twenty-four hours after infection, with severe chills, high temperature and rapid pulse. The uterine discharge is foul-smelling, dark and purulent. Uterine pains are common. Chills are usually repeated, toxemia and septicemia occur and death usually soon follows. If the case does not end fatally a chronic form of the septic endometritis often continues to give symptoms. These are chiefly leukorrheal discharge, menstrual disturbances, vague pelvic pains and sterility.

Tuberculous endometritis is secondary to the same condition elsewhere, either pulmonary, urinary, or vaginal. Several cases have been reported in which the condition followed cohabitation with a male suffering from tuberculosis of the genital tract. The disease is also called caseous endometritis because the uterine cavity is soon filled with cheesy matter. The wall becomes thickened but softer

and friable, so that rupture may occur. The condition is of chronicity and the symptoms not distinctive. A bit of the infected tissue should be examined microscopically, thereby confirming the diagnosis.

Endocervicitis is a very common infection of the intracervical mucous membrane, usually caused by the gonococcus. The gonorrheal infections of the female genital tract first involve the cervix and then extend to the uterus and tubes. C. J. Miller (*Surg., Gynec. & Obst.*, 1923, 46: 337) states that trauma is a predisposing cause, the disease itself furnishing the necessary irritation and the resulting erosion being akin to abnormal cell formation. This disease is of great importance because of its frequent relation to spontaneous postoperative and postpartum infection, and to the potentiality of transition to malignancy. The gonococcus burrows deeply into the tissues; there is never spontaneous cure but the disease extends upward by continuity of tissue and by lymph-channels. The chief symptom is leukorrhea, the discharge being thick, viscid, transparent, yellowish if pus is present, and sometimes mixed with a small amount of blood. Menstruation is irregular, and the flow usually increased. The patient complains of pain in the back and down the legs which is increased by standing or walking. Sterility is a frequent finding. Upon examination the cervix is seen to be large, puffy, frequently patent to the internal os and soft and eroded or hard and covered with cystic masses or polypoid nodules. The os is filled with a plug of tenacious mucus and there is frequently an area of ulceration on the posterior lip. Differentiation from endometritis is often uncertain, the two conditions being so commonly found at the same time.

Hematometra

Hematometra is a condition in which the uterine cavity becomes filled with blood when there is no outlet to the menstrual flow. The condition is seen with an imperforate hymen and appears when the menstrual periods begin. Other much rarer causes are absence of the vagina, atresia of the cervix and double uterus with one imperforate. The cervix and uterus become filled with blood but if blood is present in the tubes it comes directly from the tubal mucous membrane rather than by a backflow from the uterus. The size of the tumor depends on the quantity of retained blood; if large, a mass may be felt filling the pelvis and extending up to the abdomen. Pressure symptoms on the bladder and rectum are present. The hematometra may rupture or, becoming infected, give rise to peritonitis. Amenorrhea is of course the main sign with the pelvic tumor increasing in size and with increased pain at each menstrual period.

Subinvolution

Subinvolution of the uterus is an arrest in the return of that organ to normal size following a pregnancy or abortion. The organ remains hypertrophied, the walls thick and soft, the endometrium swollen, and the ligaments thick and elongated so that a malposition gradually occurs. The condition may follow infections of the uterus during the puerperium, tears of the cervix or perineum and uterine displacements which interfere with the blood supply. Symptoms include lumbosacral pain and a bearing-down sensation in the pelvis, an increased menstrual

flow, and leukorrheal discharge. The general health is impaired, the patient becoming anemic and suffering from occipital headaches, constipation, loss of strength and neurasthenia. Upon bimanual examination the uterus is found enlarged, not tender, the walls soft, the cavity deepened and the whole organ often displaced. The condition is not commonly found.

Chronic subinvolution of the uterus is also called myofibrosis or chronic metritis. The condition is present most frequently in women who have borne children and are approaching the menopause. The uterus is enlarged, the walls thick and hard. Bleeding may be the only symptom and will confuse the condition with a malignant growth. Careful curettage of the uterus must be carried out and a microscopic examination made of the mucosa to rule out malignancy.

Superinvolution

Superinvolution or puerperal atrophy is a condition in which the uterus becomes smaller than normal after labor or abortion. The condition is very rare and its cause unknown; suggested factors in etiology are severe postpartum hemorrhage, infection, protracted lactation and weakening diseases during or just after the puerperium. The uterine atrophy leads to amenorrhea and sterility and these, in turn, to neurasthenia.

Hernia of Uterus

Hernia of the uterus, or hysterocele, is a very rare condition in which the uterus is found in a hernial sac. Cases have been reported in a crural and inguinal hernia and in two reports pregnancy occurred and the fetus developed until the fourth month. Bimanual examination will show the uterus missing from its normal position. In the hernial sac there will be found a firm mass having the general size and shape of the uterus which moves slightly when pressure is made on the vaginal vault.

Hypertrophy of Endometrium

Hypertrophy of the endometrium is a very common condition in which the uterine mucosa is swollen and thickened, the glands enlarged and the entire uterus increased in size. The cause is unknown but fibroids and a very mild degree of inflammation are considered factors. The main symptom is profuse bleeding at the menstrual period with prolonged duration and excessive blood loss. The patient is often anemic, weakened and underweight. At times there is a watery discharge for a few days after the menstrual flow. It is of greatest importance to differentiate this condition from malignancy of the uterus. To this end tissue removed by curettage must be carefully examined microscopically. The benign hypertrophy has an excellent prognosis.

Laceration of Cervix

Laceration of the cervix occurs frequently during childbirth even when the labor is normal; in cases requiring surgical interference such injuries are so common as to be almost expected and are then due to incomplete obliteration of the cervix before the passage of the child. Conditions leading to cervical tears are precipitate delivery,

abnormal presentation, premature rupture of the bag of waters, improper use of forceps, ergot or mechanical or digital dilatation. Most of the tears are small and heal spontaneously without giving symptoms. Evidence of them, however, always remains and is one of the main signs of a previous pregnancy. Lacerations may be unilateral, bilateral, multiple, complete or incomplete. When symptoms do occur they are not pathognomonic but rather concern the underlying or associated conditions which are subinvolution of the uterus, displacements or endometritis. A leukorrheal discharge is the most common and troublesome complaint; others are pain in the lower regions of the back, a bearing-down sensation in the pelvis, headaches, menorrhagia or metrorrhagia, repeated abortions and sterility. Predisposes to carcinoma.

Hypertrophy of Cervix

Hypertrophy of the cervix is a rather common condition which may be supravaginal, infravaginal or only apparent. In every case it is due to an abnormal development and is rare in women who have borne children. In the supravaginal variety there is a partial or pseudoprolapse of the uterus, so that the cervix may appear at the vulvovaginal orifice. Upon digital examination the vagina is found to be normal in length on the posterior wall while the anterior wall, to which the cervix is attached at a lower level, is definitely shortened. Symptoms will be similar to those of uterine prolapse. In the infravaginal variety there is an increase in the length of the cervix but the diameter remains practically normal. The cervix may protrude into the vagina so far that it interferes with sexual intercourse. Sterility is the most common complaint but in a severe case walking may cause irritation of the enlarged cervix. In such a condition there is no relaxation of the vaginal walls, the fundus is in its normal position and the length of the cervix is not shortened in the knee-chest position, as it is in prolapse of the uterus.

Polypi of Cervix

Cervical polypi are usually mucous in nature but may be fibroid or papillary. The mucous type arises from the intracervical mucosa and is the result of inflammation which closes the mouths of the ducts. Distention occurs with a constriction of the base so that a mass of the mucous polypi may protrude from the external os. Fibroid polypi begin as small nodules which grow into the cervical canal and become pedunculated on a long, slender stalk so that they may escape from the external os and lie in the vagina. The papillary variety is rare but resembles papillomatous outgrowths elsewhere. Leukorrhea is the most common complaint and is due to inflammation and irritation of the cervical mucous membrane. Menorrhagia and dysmenorrhagia are usually present and uterine bleeding may occur in varying amounts following exertion, straining at stool or sexual intercourse. When the polypus hangs into the vagina it may easily be seen; when intracervical it will be discovered by dilatation and curettage. L. R. Thompson advocates transillumination of the cervix to demonstrate polypi, cysts or other obscure conditions. The procedure is simple and should be a part of the routine pelvic examination. (See *J. Am. M. Ass.*, 1926, 86:1437.) Every specimen so removed must be examined microscopically so that malignancy will not be overlooked.

Eversion of Intracervical Mucosa

Eversion of the intracervical mucosa is the result of trauma, inflammation, or congenital defect of the external os uteri. The most frequent trauma is a laceration sustained in childbirth. Endocervicitis with an hypertrophy of the mucous membrane is a common cause. The symptoms are indefinite, but leukorrhea is the most frequent complaint. The condition is readily diagnosed by inspection of the cervix. Malignant disease must be differentiated from eversion of the mucosa.

Atresia and Stenosis of Cervix

Atresia of the cervix is a complete obliteration of the canal; stenosis is a narrowing or stricture of the canal. Either condition may be the result of *congenital* malformations or *acquired* from trauma of labor, faulty operations, pessary or from a cancerous growth. With complete closure there is a damming-back of the menstrual flow into the uterus (hematometra) and eventually the tubes also become distended with blood (hematosalpinx). Amenorrhea with general constitutional symptoms follows. The uterine cavity will be filled with mucus or pus after the climacteric. The symptoms will depend upon the age of the patient, relation to menstrual period and to the nature of the uterine contents. Before the menopause, signs and symptoms of an hematometra will be present. If infection occurs within the uterus, the blood will be replaced by pus and all the evidences of a severe septic process will appear. After the climacteric, atresia or stenosis of the cervix will give no symptoms on their own account but signs of the underlying condition will be present.

Chancre of Cervix

Chancre is found very rarely on the cervix but may be present on either the anterior or posterior lip; it is usually single, may be multiple and resembles in all respects a primary luetic sore elsewhere. The cervical canal may be involved in the ulceration. The lymph-nodes within the pelvis are involved but the inguinal nodes remain normal.

AFFECTIONS OF THE VAGINA

Malformations

Malformations of the vagina are the result of abnormal development of the müllerian ducts and therefore frequently coexist with anomalies of the uterus, although they may be found alone. There may be a persistent cloaca with an opening from the rectum into the vagina through which feces escape; the anus is usually absent in such a case. The vagina may be *double* with a septum running lengthwise through it, a continuation of the same condition frequently present in the uterus. The vagina may be *entirely absent* or lacking only in part; such a malformation is usually associated with absence or an anomalous development of the uterus, tubes or ovaries; this condition is also found with complete absence of the vulva. There may be no symptoms of an absence of the vagina until puberty but if the uterus is present and functioning, there will then be a damming-back of the menstrual flow with the formation of a hematometra. There may be found a stenosis of the vagina, the result

of failure in development of the lower end of one müllerian duct. The canal is contracted and usually situated to one side of the median line. All these conditions are readily determined by inspection and palpation.

Injuries

Injuries to the vagina are not common unless received during childbirth. The organ may be lacerated by a foreign body with a sharp edge. During delivery the vagina may be torn by a large child, abnormal presentation, precipitate delivery, improper use of forceps or digital exploration. Sexual intercourse is a rare cause of vaginal injury but may occur if there is great disproportion between the male and female organs, if brutal violence is used, if there is contraction from age, or if any congenital malformation is present. Lacerations of the vagina may be of three degrees, *i.e.*, first degree, when only the mucous membrane is torn; second, when the laceration includes all the structures to the rectum, and third degree, when the tear extends into the rectum and the anal sphincter is severed. Rarely the tear may extend through the vaginal vault into the peritoneum or injure the bladder or ureters. The symptoms will depend upon the severity of the laceration and injury to other structures. In a very slight tear occurring during labor there may be no symptoms because of the edema and stretching of the tissues. When symptoms are present they include pain in the vagina, some bleeding, and interference with intercourse. In a severe extensive tear there will be shock and severe pain; the edges of the torn external sphincter will appear as a dimple on either side of the anus as the muscle-fibers retract. Incontinence of feces is most troublesome. In all these conditions the diagnosis is made by inspection and palpation.

Cystocele

A cystocele is a prolapse of the bladder which pushes before it the anterior wall of the vagina. It is the result of a weakened pelvic floor and perineum and is caused by relaxation or lacerations during childbirth, subinvolution or prolapse of the uterus. The condition is very common, especially among the poorer classes of women who have borne several children without medical attention. Symptoms usually appear in the latter part of the third decade and may increase in severity as the relaxation of old age comes on. There is a heavy, dragging sensation in the pelvis caused by the general displacement of the pelvic organs. This is definite only when the cystocele is of a fair size; it is relieved by lying down. A feeling of distention at the vulvovaginal orifice due to the bulging of the anterior vaginal wall and bladder is the most frequent complaint. The bulging is increased by coughing or straining, but can be reduced by direct pressure. Urinary disturbances are usually marked with frequency, residual retention or tenesmus. The diagnosis is usually easily made by direct inspection and palpation. When the patient strains the increased bulging of the anterior vaginal wall is readily seen. A positive diagnosis is made by the introduction of a curved sound into the urethra, the point of which is then turned downward into the most prominent part of the swelling where it may be felt through the vaginal wall. Again, the bladder may be filled with sterile water and the swelling made tense; when the water is withdrawn the vaginal wall becomes relaxed and flabby.

Rectocele

A rectocele is a prolapse of the rectum which displaces the posterior wall of the vagina. It is caused by the same injuries which lead to a cystocele and resembles that condition. The same symptoms are present except that in place of the urinary difficulty there is rectal tenesmus, constipation and a feeling of fullness in the rectum even after defecation. Diagnosis is readily made by direct inspection and palpation, the bulging being more pronounced when the patient stands erect and bears down.

Hernia

A vaginal hernia is an uncommon condition in which the intestines descend anterior or posterior to the broad ligament. In the former type the protrusion starts in the vesico-uterine fold, passes between the vagina and bladder and may become visible externally at the anterior part of the labium majus. In the posterior variety, the protrusion begins in the posterior culdesac, descends between the vagina and rectum and appears at the posterior part of the labium majus. These conditions may be due to relaxations or lacerations from childbirth or to congenital malformations. The displaced intestines form a tumor which is easily palpated either anterior or posterior to the vagina. This tumor increases in size and tension, on straining or coughing, disappears with a gurgling sound on pressure, is soft and doughy to the touch and the presence of intestines increases the thickness from the vagina to the rectum or bladder.

Fistula

Fistulæ of the vagina may extend into the bladder, ureter or rectum and are termed vesicovaginal, ureterovaginal or rectovaginal. They are most frequently due to injuries received during childbirth, pressure necrosis or lacerations received from injudicious use of instruments. They may follow ulcerations caused by a pessary worn over a long period of time. Rarely, these fistulæ may appear in the late stages of a carcinomatous growth with extensive sloughing and necrosis. Depending on the type, urine or feces may be discharged through the vagina, causing irritation and excoriation, and impairing the general health. Diagnosis is made by direct inspection; a probe may be inserted into the fistulous tract. In some cases the opening into the vagina is so small or hidden that it is difficult to find. When a vesicovaginal fistula exists under these conditions it can often be demonstrated by having the patient urinate while the urethral opening is held closed; the urine may then be seen escaping into the vagina.

Inflammation

(*Vaginitis*)

An inflammation of the vagina can exist only when the normal secretions are interfered with so that their bactericidal powers are destroyed. The disease may be present in several varieties, *i.e.*, simple, gonorrheal, granular, senile or emphysematous.

The *simple* type is a non-specific inflammation characterized by an increased

discharge from the vaginal glands. It may be primary from irritation of pessaries, excessive venery, labor, caustic applications or general debilitating diseases; the secondary variety arises from irritating uterine discharges, inflammation of the vulva, or infection of the kidneys, bladder or urethra. The patient complains of a feeling of heat and pain in the vagina, discomfort in the perineum and pelvis and low backache made worse by exertion. The discharge, at first thin, white and mucoid, soon becomes yellowish and of a thick creamy consistency. The urethra is not involved in the inflammatory process which is an important differential point from gonorrheal vaginitis. The mucous membrane of the vagina is hot, red, swollen and tender to the touch.

Gonorrheal vaginitis begins acutely with symptoms similar to the simple type but of greater severity. The discharge is profuse and purulent, and the inflammation spreads to the urethra, cervix, uterus and tubes. Chronic vaginitis due to the gonococcus is very common; it may follow the acute type or be subacute from its inception. It is very frequent in children. Symptoms are the same as those found in the simple variety with exacerbations during the menstrual period.

Either the simple or gonorrheal inflammation may lead to the *granular* or papillary type of vaginitis. The papillæ of the vagina become infiltrated and the mucous membrane is covered with small granulations. Symptoms are similar to those already given.

Senile vaginitis occurs after the menopause and is due to atrophic changes accompanying old age. Symptoms are usually very slight and may be only those of a thin, serous leukorrheal discharge. Objectively the mucous membrane of the vagina is found smooth, atrophied and with several small areas of ecchymosis and ulceration and resulting adhesions.

Emphysematous vaginitis is a type found in pregnant women in which the vagina is covered with small cysts filled with gas. Symptoms may be only those of a slight leukorrheal discharge. The condition is readily diagnosed by inspection. The cysts may rupture spontaneously, the gas escapes and a cure result without treatment.

Cysts

Cysts of the vagina are not common but they are found more frequently than any other tumors in this region. Most of them are probably embryonic in origin, and exist as retention, epithelial inclusion, hydatid or dermoid cysts. They may be found in the newborn but usually escape notice until adult life. The cyst may be present in any portion of the vagina with the overlying skin normal or ulcerated. The symptoms will depend upon the size and location of the cyst. With a small nodule, symptoms may be entirely lacking; with a large cyst, symptoms are chiefly mechanical with pressure on the bladder or rectum or obliteration of the vaginal cavity.

Tumors

Tumors of the vagina are not common but the most frequent benign form is the *fibromyoma*. They are similar to the same tumors in the uterus and occur at the same age period. They are usually single, slow growing, varying in size from a bean to a fist, and are either sessile or pedunculated. They do not increase in size or tension

on coughing, nor do they disappear on pressure. They may become edematous, ulcerated or gangrenous. The small ones give no symptoms but if of large size they will give pressure symptoms on the bladder and rectum and obstruct intercourse or labor.

Papillomata of the vagina are infrequent but often associated with the same condition in the vulva. They are covered with normal epithelium and have an uninfiltrated healthy base. They must not be confused with malignant growths.

Carcinoma of the vagina is very rarely primary but secondary cases due to direct extension or metastasis are not uncommon. The symptoms are bleeding after coitus, pruritus and a mucopurulent discharge which becomes offensive. Extension causes dull pain in the pelvis radiating to the legs, painful micturition and defecation. Emaciation and cachexia develop; a urinary or fecal fistula may appear and septicemia or uremia may cause death. Primary *epithelioma* may occur.

Sarcoma of the vagina is even more rare than carcinoma. It usually occurs earlier in life, may be primary but more often is secondary, and gives rise to the same symptoms as carcinoma. The usual situation is in the lower part of the vagina from whence extension occurs directly or by the blood stream. The bladder, rectum and later the ureters and kidneys become involved. Bleeding is the chief symptom but does not occur until ulceration takes place; it is at first mild, later on increasing in amount. When there is ulceration there is a foul watery discharge and pain in the pelvis.

Hematocolpos

Hematocolpos is a condition in which the vagina becomes distended with menstrual blood as the result of an imperforate hymen. Symptoms appear when the menstrual flow begins and grow more severe as the distention increases. There is a sensation of increasing fullness with colicky pains in the pelvis at each menstrual period. Pressure on the bladder or rectum may be complained of. Backward pressure of the blood may cause distention of the uterus (hematometra).

AFFECTIONS OF THE VULVA

Malformations

Malformations of the vulva are fairly frequent, usually occurring with some other imperfect development of the genital tract. There may be complete or partial absence, an infantile form or hypertrophy of the whole or any part. Often the external genitalia are so deformed that portions of both male and female appear to be present in one individual. Such people are called hermaphrodites, but the presence of either ovary or testicle determines exactly the sex. True hermaphrodites are very rare.

Injuries

Injuries to the vulva are not common because of its protected position; they are, however, of great importance due to the abundant vascular supply and proximity to the bones of the pelvis. These injuries are sustained most frequently during labor as the result of prolonged pressure and injudicious use of forceps and hands. They are usually contusions or lacerations. Direct injury results from blows, kicks or falls astride an object. Symptoms of injury are local pain, bleeding which may be very profuse and even fatal, impaired function and occasionally shock.

Inflammations

Inflammation of the vulva may be simple catarrhal, gonorrheal, or follicular.

The *simple catarrhal* variety is the result of irritation, general diseases such as diabetes, and blows or falls; the condition causes local pain and tenderness. Urination may increase the symptoms, due to contact of urine with the inflamed surfaces. The discharge is profuse and mucopurulent, frequently causing irritation of the anus or thighs.

Gonorrheal vulvitis is the most common type of inflammation which attacks the external genitals. Besides extending to involve the urethra, Bartholin's and Skene's glands and the vagina, it spreads to the uterus and tubes. The symptoms and signs are the same as in the catarrhal type but they are more severe and are accompanied with greater urinary disturbance. The diagnosis is confirmed by the presence of gonococci in the secretions.

Follicular vulvitis is similar to follicular vaginitis and may follow the simple or gonorrheal types. The surfaces of the labia and prepuce are covered with small red elevations which cause pruritus, irritation and hyperesthesia.

Tumors

Benign tumors of the vulva are rare but all of the common types such as fibroma, myoma, myxoma, lipoma, neuroma, angioma and verruca have been reported. When small there may be no symptoms but if of large size they give mechanical interference and are exposed to the irritation of urine, vaginal discharges and feces. They may cause pressure on the bladder or rectum or interfere with intercourse. The overlying skin frequently becomes ulcerated and deep necrosis may follow.

Malignant tumors of the vulva are also rare; squamous or cylindric-celled carcinoma* are the most common. The condition usually occurs between forty and sixty and in many cases seems to follow chronic irritation. The depression between the labium majus and the nymphæ is the most frequent site but any region may be affected. Pruritus is an early and constant symptom. The early nodule increases in size, discharges a thin, watery fluid with a foul odor and bleeds easily from its ulcerated surface. The margins and base of the growth are irregular and indurated which distinguishes an early case from syphilis. Sarcoma of the vulva is very rare; it resembles the same condition in the vagina.

Syphilis

Chancre is not commonly found on the vulva; perhaps, because of the conformation and relations of the parts, it is easily overlooked. The most frequent situation is on the labia majora, then the fourchet, nymphæ and clitoris. The characteristic induration may be absent in these regions with only superficial ulceration. Every suspicious case should be examined for the *Spirochæta pallida*.

Cysts

Cysts of the vulva are comparatively rare but may result from obstruction of sebaceous glands, dilated lymph-vessels or dermoid tumors. They are usually small

in size and give no symptoms. Inflammation and suppuration may occur. If the cyst is large it may interfere with walking or intercourse.

Kraurosis Vulvæ

Kraurosis vulvæ is a progressive atrophy of the skin in which the tissues become white, tense, shining, dry and brittle. The cause is not known. Symptoms are local pain and burning, pruritus and extreme sensitiveness. Diagnosis is easily made by inspection.

Elephantiasis

Elephantiasis is a chronic hypertrophic disease of the skin with an increase in size of the affected part. The condition is endemic in tropical countries, and is due to the *Filaria sanguinis hominis* and appears between the ages of twenty-five and fifty. Some authors consider it may be due to a chronic local obstruction to the circulation arising from traumatism, lymphangitis or erysipelas. Symptoms are due mainly to mechanical interference in walking, urinating or defecating or in sexual intercourse. There may be a sensation of weight, pruritus or an irritative discharge. The affection is most common in the labia majora, then the clitoris and least in the nymphæ. The surface of the tumor mass is hard and it may be smooth or warty. Fissures, excoriations, ulcerations, edema and more or less pigmentation usually occur.

Varicose Veins

Varicose veins of the vulva are due to the pressure of a pregnant uterus or other conditions interfering with the venous return from this region, *i.e.*, pelvic adhesions, abdominal or pelvic tumors, chronic constipation with straining at stool, prolonged standing and heavy lifting. The veins affected become dilated, elongated, tortuous and knotty. If the condition is slight there may be no symptoms, but if marked, there will be a sensation of weight in the vulva with aching, itching and burning. The affected veins are easily seen and palpated in the labia majora, less frequently in any other part.

Hydrocele of Labium Majus

A hydrocele of the labium majus is a collection of fluid in the canal of Nuck which normally is obliterated after birth but which may remain patulous about the round ligament. The condition is very rare. The fluid is thin and straw-colored but may contain blood or pus and be sealed off from the peritoneal cavity. There are no symptoms unless the swelling is sufficiently large to interfere with walking, labor or intercourse. The swelling is painless, elastic, fluctuant, translucent, disappears on pressure or upon lying down and is increased by coughing or straining.

Pruritus Vulvæ

Pruritus vulvæ is an intense itching of the external genitals which may be caused by a large number of conditions. Of these the most common are local diseases of the vulva such as vulvitis, varicose veins, edema and eruptions. Irritating discharges

from the tubes, uterus, cervix, vagina, kidneys, bladder or urethra may be the underlying cause. The condition also follows traumatism with inflammation, lack of cleanliness, cystocele, rectocele, hemorrhoids and constipation. Pruritus is common at the menopause and in old age. The irritation may be constant or occur in paroxysms, and may be worse at night or following intercourse, or at the time of the menstrual period. The intense itching causes the patient to rub the parts, sometimes until excoriation occurs, and the condition is thereby aggravated. Physical exhaustion may follow loss of sleep and appetite and the increasing nervousness.

Vaginismus

Vaginismus is an hyperesthetic condition of the vulvovaginal orifice characterized by painful and spasmodic contractions of the muscles of the pelvic floor, but more especially of those surrounding the vulva and lower part of the vagina (Ashton). The condition is not common and is merely a symptom of some underlying disease. There may be the traumata and inflammations so common in recently married women, a urethral caruncle, a fissure at any portion of the external genitalia, a neuroma of the fossa navicularis or a prolapse of the urethral mucous membrane; fear of injury or pain during intercourse and disproportion of male and female genital organs—these are etiologic factors. Finally neurosis and hysteria are considered as causes but it must not be forgotten that frequently they are rather the result of the condition. Symptoms may be slight or very severe. The contracture of the pelvic floor muscles is an important sign in differentiating the condition from dyspareunia (painful intercourse) where pain is the only symptom.

CHAPTER IX

THE EXTREMITIES

AFFECTIONS OF THE EXTREMITIES: SHOULDER, SHOULDER JOINT, UPPER ARM, ELBOW

Shoulder

- | | |
|---|---|
| <p>A. Congenital malformations</p> <ol style="list-style-type: none"> I. Partial or complete absence of clavicle II. Elevation of shoulder (Sprengel's deformity) III. Dislocation of shoulder <p>B. Injuries</p> <ol style="list-style-type: none"> I. Skin (avulsion of) II. Muscles <ol style="list-style-type: none"> (a) Wounds (incised) (b) Subcutaneous rupture <ol style="list-style-type: none"> 1. Deltoid 2. Pectoralis major 3. Pectoralis minor 4. Coracobrachialis 5. Subscapularis 6. Teres major 7. Biceps 8. Trapezius 9. Trapezoid 10. Serratus anterior III. Ligaments <ol style="list-style-type: none"> (a) Wounds (incised) (b) Subcutaneous rupture <ol style="list-style-type: none"> 1. Acromioclavicular 2. Coraco-acromial 3. Biceps (long tendon) 4. Coracoclavicular IV. Blood-vessels <p style="padding-left: 20px;">Wounds of</p> <ol style="list-style-type: none"> 1. Axillary 2. Subclavian 3. Subscapular 4. Circumflex V. Nerves <ol style="list-style-type: none"> (a) Pressure (b) Contusions, brachial plexus (especially accessory circumflex) VI. Joints <ol style="list-style-type: none"> (a) Sprains (b) Wounds (c) Contusions <p>C. Affections of bursæ</p> <ol style="list-style-type: none"> I. Subacromial <ol style="list-style-type: none"> (a) Inflammation <ol style="list-style-type: none"> 1. Acute 2. Acute suppurative 3. Chronic | <ol style="list-style-type: none"> (b) Hematoma (c) Arthritic deposits <p>II. Subdeltoid</p> <ol style="list-style-type: none"> (a) Inflammation <ol style="list-style-type: none"> 1. Acute or spasmodic 2. Subacute or adherent 3. Chronic or non-adherent 4. Acute suppurative (b) Hematoma (c) Arthritic deposits (d) Tuberculosis (rice-body hygroma) <p>III. Clavicular</p> <p style="padding-left: 20px;">Chronic inflammation</p> <p>D. Axilla (See "Affections of axilla")</p> <p>E. Soft parts</p> <ol style="list-style-type: none"> I. Inflammations <ol style="list-style-type: none"> (a) Acute (b) Acute suppurative (c) Boils (d) Carbuncles (e) Chronic II. Granuloma <ol style="list-style-type: none"> (a) Tuberculosis (b) Actinomycosis (c) Syphilis (gumma), very rare III. Tumors <ol style="list-style-type: none"> (a) Benign <ol style="list-style-type: none"> 1. Sebaceous cyst 2. Papilloma 3. Lipoma 4. Fibroma 5. Angioma 6. Nevus 7. Keloid 8. Neuroma 9. Pachydermatocele 10. Ossification of deltoid (shooting bone) 11. Chondroma (b) Malignant <ol style="list-style-type: none"> 1. Sarcoma 2. Carcinoma <p>F. Bone</p> <ol style="list-style-type: none"> I. Inflammation <ol style="list-style-type: none"> (a) Acute periostitis (b) Acute osteitis (c) Acute osteomyelitis (d) Chronic osteomyelitis |
|---|---|

*Shoulder (Continued)*F. Bone (*cont.*)

II. Granuloma

- (a) Tuberculosis
- (b) Syphilis (gumma)

III. Tumors

- (a) Benign
 - 1. Osteoma
 - 2. Chondroma
- (b) Malignant
 - 1. Sarcoma, various types
 - 2. Carcinoma (secondary)

G. Joints

I. Sternoclavicular

- (a) Acute inflammation
- (b) Chronic inflammation
- (c) Tuberculosis
- (d) Neuropathic arthritis

II. Acromioclavicular joint

- (a) Acute inflammation
- (b) Chronic inflammation
- (c) Tuberculosis
- (d) Neuropathic arthritis

III. Shoulder joint

- (a) Inflammation
 - 1. Acute
 - 2. Acute purulent
 - 3. Gonorrheal
 - 4. Chronic
 - 5. Typhoid
- (b) Granuloma
 - Tuberculosis
 - i. Caries sicca
 - ii. Caries carnea

- (c) Acute articular rheumatism

- (d) Neuropathic arthritis

- (e) Contracture

- (f) Ankylosis

- (g) Arthritis deformans

- (h) Flail joint

- (i) Papillary synovitis

IV. Scapula

- (a) Inflammation

- 1. Acute periostitis

- 2. Acute osteitis

- 3. Acute osteomyelitis

- 4. Chronic osteomyelitis

- (b) Granuloma

- 1. Tuberculosis

- 2. Syphilis (gumma)

- (c) Tumors

- 1. Benign

- i. Exostosis

- ii. Osteoma

- iii. Fibroma

- iv. Chondroma

- 2. Malignant

- i. Osteosarcoma

- ii. Chondrosarcoma

- iii. Colloid chondroma (usually malignant)

- iv. Cystic chondroma (usually malignant)

V. Exostosis

Upper Arm

A. Congenital malformations

- I. Abrachia (absence of arms)
- II. Monobrachia (absence of one arm)
- III. Perobrachia (rudimentary formation of arm)
- IV. "Spontaneous amputation"
- V. Hypertrophy

B. Injuries

- I. Skin and subcutaneous tissue
 - (a) Wounds
 - (b) Contusions
 - (c) Avulsion of skin
- II. Muscles
 - (a) Wounds
 - (b) Subcutaneous rupture
 - 1. Biceps (especially long head)
 - 2. Coracobrachialis
 - 3. Triceps
 - (c) Hernia (usually biceps and triceps)
 - (d) Ossification (over muscle groups)

III. Blood-vessels

Brachial and its tributaries

IV. Nerves (pressure, contusion, laceration)

- 1. Musculospiral

- 2. Median

- 3. Ulnar

C. Affections of soft parts of upper arm

I. Skin and subcutaneous tissues

- (a) Inflammation

- 1. Furuncle

- 2. Carbuncle

- 3. Lymphangitis

- 4. Erysipelas

- 5. Cellulitis

- 6. Emphysematous gangrene

- (b) Tuberculosis

- (c) Tumors

- 1. Any of benign tumors

- 2. Occasionally primary epithelioma

- 3. At times carcinoma (secondary)

AFFECTIONS OF THE EXTREMITIES: SHOULDER, SHOULDER JOINT, UPPER ARM, ELBOW (*Cont.*)*Upper Arm (Continued)*C. Affections of soft parts of upper arm (*cont.*)

II. Muscles

- (a) Acute myositis
- (b) Abscess
- (c) Myositis ossificans
- (d) Cavernous angioma
- (e) Syphilis
 - 1. Myositis
 - 2. Gumma
- (f) Sarcoma

III. Blood-vessels

- (a) Aneurysm
- (b) Cirroid aneurysm (congenital)
- (c) Arteriosclerosis
 - 1. Thrombosis
 - 2. Embolism

IV. Nerves

- (a) Neuritis
- (b) Neuroma
 - 1. Benign
 - 2. Malignant
 - i. Sarcomatous degeneration
 - ii. Myxosarcomatous degeneration

V. Bursæ

Olecranon

- 1. Acute inflammation
- 2. Chronic inflammation
- 3. Tuberculosis

VI. Lymph glands (cubital)

- (a) Acute inflammation

- (b) Chronic inflammation
- (c) Hyperplasia
- (d) Leukemia (lymphatic)
- (e) Hodgkin's disease
- (f) Tuberculosis
- (g) Actinomycosis
- (h) Syphilis
- (i) Sarcoma
- (j) Carcinoma

D. Affections of humerus

I. Inflammations

- (a) Acute periostitis
- (b) Acute osteomyelitis
- (c) Abscess
- (d) Chronic osteomyelitis

II. Granuloma

- (a) Tuberculosis (of shaft)
- (b) Syphilis
 - 1. Osteochondritis
 - 2. Gummatous osteitis

III. Aneurysm

IV. Echinococcus cyst

V. Rachitic deformities

VI. Tumors

- (a) Benign
 - 1. Cyst
 - 2. Exostosis
 - 3. Chondroma
 - 4. Osteoma
- (b) Malignant
 - 1. Sarcoma, various types
 - 2. Carcinoma (secondary)

Elbow

Elbow Joint (Proper)

A. Congenital anomalies

- I. Phocomelus
- II. Hemimelus
- III. Cubital varus
- IV. Cubital valgus
- V. Dislocation of radius and ulna
- VI. Dislocation of ulna
- VII. Dislocation of radius
- B. Injuries
 - I. Wounds
 - II. Contusions
 - III. Sprains
 - IV. Subluxation of radius ("pulled elbow")

C. Diseases

I. Inflammation

- (a) Acute serous (including gonorrhea, rheumatism)
- (b) Acute purulent
- (c) Chronic (gout, arthritis deformans, neuropathic origin)

II. Granuloma

- (a) Tuberculosis
- (b) Syphilis

III. Tuberculosis

IV. Tumors

Lipomata

V. Foreign bodies

Soft Tissues of Elbow

A. Injuries

I. Wounds

- (a) Skin
- (b) Subcutaneous tissue
- (c) Muscles
- (d) Blood-vessels
 - 1. Cubital

2. Ulnar

3. Radial

Nerves

- 1. Radial
- 2. Median
- 3. Ulnar

II. Contracture of elbow

AFFECTIONS OF THE EXTREMITIES: SHOULDER, SHOULDER JOINT, UPPER ARM, ELBOW (*Cont.*)Soft Tissues of Elbow (*Continued*)

B. Diseases

I. Skin

(a) Inflammation

1. Furuncle
2. Carbuncle
3. Acute inflammation
4. Chronic inflammation
5. Cellulitis

(b) Anthrax

(c) Tuberculosis

(d) Tumors

II. Bursæ (olecranon)

(a) Acute inflammation

(b) Chronic inflammation

("miner's elbow")

(c) Tuberculosis

(d) Syphilis (extremely rare)

III. Tendon sheaths (See "Diseases of Tendon Sheaths")

IV. Blood-vessels

(a) Cubital

(b) Ulnar

(c) Radial

1. Aneurysm

2. Embolus

3. Thrombus

V. Nerves

(a) Radial

(b) Median

(c) Ulnar

Inflammation

i. Acute

ii. Chronic

AFFECTIONS OF THE EXTREMITIES: FOREARM, WRIST, HAND AND FINGERS

Forearm

A. Congenital malformations

I. "Spontaneous amputation"

II. Rudimentary formation

III. Hypertrophy

IV. Absence of radius or ulna

V. Congenital pronation of forearm

B. Injuries

I. Skin and subcutaneous tissue

(a) Wounds

(b) Contusions

(c) Avulsion of skin

II. Muscles

(a) Wounds

(b) Subcutaneous rupture

(c) Hernia

(d) Ossification, traumatic osteoma

III. Blood-vessels

(a) Radial

(b) Ulnar

IV. Nerves

(a) Radius

(b) Ulnar

(c) Median

1. Pressure

2. Contusion

3. Laceration

4. Amputation neuroma

V. Bones

(a) Radius

(b) Ulna

Fractures

C. Affections of soft parts of forearm

I. Skin and subcutaneous tissue

(a) Inflammation

1. Furuncle

2. Carbuncle

3. Lymphangitis

4. Erysipelas

5. Cellulitis

6. Emphysematous gangrene

7. Anthrax

8. Actinomycosis

9. Sporotrichosis

(b) Tuberculosis

1. Lupus

2. Metastatic tubercle

3. Lymphangitis

(c) Tumors

1. Any benign tumors

2. Primary epithelioma

3. Carcinoma (secondary)

4. Sarcoma

II. Muscles

(a) Acute myositis

(b) Abscess, pyogenic or tuberculous

(c) Myositis ossificans

(d) Syphilis, myositis or gumma

III. Blood-vessels

(a) Aneurysm

(b) Cirroid aneurysm (congenital)

(c) Arteriosclerosis

(d) Thrombosis

(e) Embolism

IV. Nerves

(a) Radial

(b) Ulnar

AFFECTIONS OF THE EXTREMITIES: FOREARM, WRIST, HAND AND FINGERS (*Continued*)*Forearm (Continued)*C. Affections of soft parts of forearm (*cont.*)IV. Nerves (*cont.*)

(c) Median

1. Neuritis

2. Neuroma

i. Benign

ii. Malignant

D. Affections of bones of forearm

I. Radius

(a) Inflammation

1. Acute periostitis

2. Acute osteomyelitis

3. Chronic osteomyelitis

4. Abscess

(b) Granuloma

1. Tuberculosis (of shaft)

2. Syphilis

i. Osteochondritis

ii. Gummatous osteitis

(c) Aneurysm

(d) Echinococcus cyst

(e) Rachitic deformities

(f) Tumors

1. Benign

i. Cyst

ii. Exostosis

iii. Chondroma

iv. Osteoma

2. Malignant

i. Sarcoma, various types

ii. Carcinoma

II. Ulna

Same as under radius

Wrist

Joint Proper

A. Congenital malformations

I. Simple dislocation

II. Club-hand (manus vara)

B. Injuries

I. Wounds

II. Contusions

III. Sprains

IV. Dislocations and fractures

C. Diseases

I. Inflammation

(a) Acute serous including gonorrhea, rheumatism

(b) Acute purulent

(c) Chronic (gout, arthritis deformans, neuropathic origin)

II. Syphilis

(a) Chronic serous

(b) Chronic gummatous

III. Tuberculosis

IV. Tumors

(a) Benign

(b) Malignant

V. Foreign bodies

Soft Tissues about Wrist

A. Injuries

I. Wounds

(a) Skin

(b) Subcutaneous tissue

(c) Muscles and tendons

(d) Blood-vessels

1. Ulnar

2. Radial

(e) Nerves

1. Radial

2. Median

3. Ulnar

II. Contracture of wrist

B. Diseases

I. Inflammation

(a) Furuncle

(b) Carbuncle

(c) Acute inflammation

(d) Chronic

(e) Cellulitis

II. Anthrax

III. Tuberculosis

IV. Tumor

C. Tendon and tendon sheath

I. Inflammation (tenosynovitis)

II. Granulomata

(a) Tuberculosis

(b) Syphilis

III. Ossification

IV. Ganglion

V. Tumors

(a) Benign

1. Fibroma

2. Lipoma

3. Xanthoma

(b) Malignant

Sarcoma

D. Blood-vessels

I. Radial

(a) Aneurysm

(b) Embolism

(c) Thrombosis

E. Nerves

I. Radial (wrist-drop)

II. Ulnar

III. Median (ape's hand)

Hand and Fingers

- | | |
|---|--|
| <p>A. Congenital malformations</p> <p>I. Absence of fingers (ectrodactyl)</p> <p>II. Supernumerary fingers (polydactyl)</p> <p>III. Suppression of fingers</p> <p>(a) Brachydactyl</p> <p>(b) Cleft hand</p> <p>IV. Hypertrophy of fingers (macroductyl)</p> <p>V. Web fingers (syndactyl)</p> <p>VI. Congenital contraction, hammer-finger</p> <p>B. Acquired deformities</p> <p>I. Madelung's spontaneous subluxation of wrist.</p> <p>II. Dupuytren's contracture of palmar fascia</p> <p>III. Trigger-finger</p> <p>IV. Mallet-finger</p> <p>V. Volkmann's ischemic contracture</p> <p>VI. Osteo-arthritis</p> <p>VII. Adhesions of tendons to their sheaths</p> <p>VIII. Deformities after nerve lesions</p> <p>(a) Syringomyelia</p> <p>(b) Raynaud's disease</p> <p>(c) Klumpke's paralysis</p> <p>C. Injuries</p> <p>I. Skin and subcutaneous tissue</p> <p>(a) Wounds</p> <p>(b) Contusions</p> <p>(c) Avulsion of skin</p> <p>II. Muscles</p> <p>III. Bones</p> <p>(a) Fractures</p> <p>(b) Dislocations</p> <p>IV. Blood-vessels</p> <p>Palmar arches</p> <p>V. Nerves</p> <p>D. Affections of soft parts of hand</p> <p>I. Skin and subcutaneous tissues</p> <p>(a) Inflammation</p> <p>1. Furuncle</p> <p>2. Carbuncle</p> <p>3. Lymphangitis</p> <p>4. Cellulitis</p> <p>5. Erysipelas</p> <p>6. Emphysematous gangrene</p> <p>7. Anthrax</p> <p>(b) Granulomata</p> <p>1. Tuberculosis (lupus)</p> <p>2. Syphilis</p> <p>i. Chancre</p> <p>ii. Secondary lesions</p> <p>3. Leprosy</p> <p>4. Actinomycosis</p> <p>5. Sporotrichosis</p> <p>(c) Tumors</p> <p>1. Benign</p> | <p>i. Warts</p> <p>ii. Cysts</p> <p>iii. Lipoma</p> <p>iv. Fibroma</p> <p>v. Angioma</p> <p>vi. Chondroma</p> <p>vii. Telangiectatic granu-
loma</p> <p>2. Malignant</p> <p>i. Primary epithelioma
(skin cancer)</p> <p>ii. Sarcoma</p> <p>iii. At times carcinoma
(secondary)</p> <p>II. Muscles</p> <p>(a) Acute myositis</p> <p>(b) Abscess</p> <p>(c) Myositis ossificans</p> <p>(d) Cavernous angioma</p> <p>(e) Syphilis</p> <p>1. Myositis</p> <p>2. Gumma</p> <p>III. Blood-vessels</p> <p>(a) Aneurysm</p> <p>(b) Thrombosis</p> <p>(c) Embolism</p> <p>IV. Nerves</p> <p>(a) Neuritis</p> <p>(b) Neuroma</p> <p>1. Benign</p> <p>2. Malignant</p> <p>V. Tendon and tendon sheaths</p> <p>(a) Inflammation (tenosynovitis)</p> <p>1. Pyogenic</p> <p>2. Gonorrheal</p> <p>3. Crepitant tenosynovitis</p> <p>4. Contracting tenosynovitis</p> <p>(b) Granulomata</p> <p>1. Tuberculosis</p> <p>2. Syphilis</p> <p>VI. Finger-nails, affections about</p> <p>(a) Inflammation</p> <p>Whitlow, felon, paronychia</p> <p>(b) Granulomata</p> <p>1. Primary chancre</p> <p>2. Paronychia syphilitica</p> <p>E. Bones of hand and fingers</p> <p>I. Inflammation</p> <p>(a) Acute periostitis</p> <p>(b) Acute osteomyelitis</p> <p>(c) Chronic osteomyelitis</p> <p>(d) Abscess</p> <p>II. Granulomata</p> <p>(a) Tuberculosis (of shaft)</p> <p>(b) Syphilis</p> <p>1. Osteochondritis</p> <p>2. Gummatous osteitis</p> |
|---|--|

AFFECTIONS OF THE EXTREMITIES: FOREARM, WRIST, HAND AND FINGERS (*Continued*)*Hand and Fingers (Continued)*

E. Bones of hand and fingers (<i>cont.</i>)	(c) Chronic (gout, arthritis deformans, neuropathic origin)
III. Tumors	II. Syphilis
(a) Chondroma	(a) Chronic serous
(b) Exostosis	(b) Chronic gummatous
(c) Sarcoma	III. Tuberculosis
F. Joints of hand and fingers	IV. Tumors
I. Inflammation	V. Foreign bodies
(a) Acute serous (including gonorrhea, rheumatism)	VI. Contractures
(b) Acute purulent	VII. Ankylosis

AFFECTIONS OF THE EXTREMITIES: HIP JOINT, THIGH, KNEE

Hip Joint

A. Congenital malformations	(c) Intertrochanteric
I. Congenital dislocations	(d) Subtrochanteric
II. Coxa vara	C. Diseases
III. Coxa valga	I. Inflammation
B. Injuries	(a) Acute serous
I. Wounds	1. Gonorrheal
II. Contusions	2. Rheumatism
III. Sprains	3. Typhoid
IV. Dislocations	(b) Acute purulent—abscess
(a) Backward	(c) Chronic
1. Ischiatic	1. Gout
2. Dorsum ilii	2. Arthritis deformans
(b) Forward	II. Syphilis
1. Obturator	Charcot's joint
2. Pubic	III. Tuberculosis
V. Fractures	IV. Tumors
(a) Pubis	Lipoma
(b) Ilium	V. Foreign bodies

Thigh

A. Congenital malformations	1. Quadriceps femoris
I. Intra-uterine amputation	2. Sartorius
II. Absence of femurs	3. Adductor longus
III. Absence of one femur	4. Biceps
IV. Shortening of femur	(c) Hernia
V. Congenital furrowing	(d) Ossification
VI. Osteogenesis imperfecta	III. Blood-vessels
VII. Cretinism	(a) Femoral artery and its branches
VIII. Achondroplasia	(b) Femoral vein and its tributaries
IX. Spastic paralysis	IV. Nerves
B. Injuries	(a) Pressure
I. Skin and subcutaneous tissue	(b) Contusion
(a) Wounds	(c) Laceration
(b) Contusions	1. Femoral
(c) Avulsion	2. Obturator
II. Muscles	3. Sciatic
(a) Wounds	V. Bone (femur) fracture
(b) Subcutaneous rupture	

AFFECTIONS OF THE EXTREMITIES: HIP JOINT, THIGH, KNEE (*Continued*)*Thigh (Continued)*

C. Affections of soft parts of thigh

I. Skin and subcutaneous tissues

(a) Inflammation

1. Furuncle
2. Carbuncle
3. Erysipelas
4. Lymphangitis
5. Cellulitis
6. Emphysematous gangrene

(b) Tuberculosis (lupus)

(c) Tumors

1. Benign

- i. Sebaceous cyst
- ii. Papilloma
- iii. Nevus
- iv. Keloid
- v. Fibroma
- vi. Lipoma
- vii. Angioma

(1) Lymph

(2) Cavernous

viii. Neuroma

2. Malignant

- i. Sarcoma
- ii. Carcinoma

II. Muscles

- (a) Acute myositis
- (b) Abscess
- (c) Myositis ossificans
- (d) Cavernous angioma
- (e) Tuberculosis
- (f) Syphilis
 1. Myositis
 2. Gumma

(g) Hernia

(h) Tumors, sarcoma

III. Blood-vessels

- (a) Aneurysm
- (b) Arteriosclerosis
 1. Thrombosis
 2. Embolism
- (c) Phlegmasia alba dolens

IV. Nerves

(a) Neuritis (sciatica)

(b) Neuroma

1. Benign

2. Malignant

V. Lymph glands (inguinal)

(a) Acute inflammation

(b) Chronic inflammation

(c) Hyperplasia

(d) Leukemia (lymphatic)

(e) Hodgkin's disease

(f) Tuberculosis

(g) Actinomycosis

(h) Syphilis

(i) Sarcoma

(j) Carcinoma

D. Affections of femur

I. Inflammations

(a) Acute periostitis

(b) Acute osteomyelitis

(c) Chronic osteomyelitis

(d) Abscess

II. Granuloma

(a) Tuberculosis (of shaft)

(b) Syphilis

1. Osteochondritis

2. Gummatous osteitis

III. Aneurysm

IV. Osteitis deformans (Paget's disease)

V. Echinococcus cyst

VI. Rachitic deformities

VII. Barlow's disease (infantile scurvy)

VIII. Tumors

(a) Benign

1. Cyst

2. Exostosis

3. Chondroma

4. Osteoma

(b) Malignant

1. Sarcoma, various types

2. Carcinoma

Knee

Knee Joint (Proper)

A. Congenital malformations

I. Congenital genu recurvatum

II. Rudimentary or absent patella

III. Posterior dislocation of tibia and fibula

IV. Genu varum

V. Genu valgum

B. Injuries

I. Wounds

II. Contusions

III. Sprains

IV. Fractures

(a) Patella

(b) Femur

(c) Tibia and fibula

V. Dislocations

VI. Displacement of patella

VII. Dislocation fracture of semilunar cartilages

VIII. Rupture of ligaments

(a) Internal lateral

(b) Crucial

IX. Snapping or trigger knee

AFFECTIONS OF THE EXTREMITIES: HIP JOINT, THIGH, KNEE (*Continued*)

Knee (Continued)

C. Diseases

I. Inflammation

- (a) Acute serous synovitis
 - 1. Traumatic
 - 2. Foreign body
 - 3. Gonorrhea
 - 4. Rheumatism
 - 5. Villous arthritis
- (b) Acute purulent
- (c) Chronic
 - 1. Gout
 - 2. Arthritis deformans
 - 3. Rheumatism
 - 4. Neuropathic origin

- 5. Secondary to flat feet
- 6. With osteomyelitis

II. Syphilis

- (a) Chronic serous
- (b) Chronic gummatous

III. Tuberculosis

IV. Tumors

- (a) Lipoma arborescens
- (b) Hypertrophied synovial fringes
- (c) Cysts
- (d) Sarcoma of articular capsule
- (e) Fibroma of articular capsule

V. Foreign bodies

VI. Intermittent hydrops

Soft Tissue about Knee

A. Injuries

I. Wounds

- (a) Skin
- (b) Subcutaneous tissue
- (c) Muscle
- (d) Quadriceps tendon and ligamentum patellæ
- (e) Blood-vessels
 - Popliteal and branches
- (f) Nerves
 - 1. Tibial or internal popliteal
 - 2. Peroneal or external popliteal
 - 3. Internal saphenous
 - 4. Internal cutaneous of crural

II. Contracture of knee

- (c) Tuberculosis
- (d) Tumors

II. Bursæ

- (a) Prepatellar (housemaid's knee)
- (b) Suprapatellar
- (c) Pretibial
 - 1. Acute inflammation of popliteal space
 - 2. Chronic inflammation
 - 3. Tuberculosis

III. Tendon sheaths (See "Diseases of Tendon Sheaths"; "Ganglion")

IV. Blood-vessels

Popliteal

- 1. Aneurysm
- 2. Embolus
- 3. Thrombus

V. Nerves

- (a) Tibial
- (b) Peroneal
 - 1. Inflammation
 - i. Acute
 - ii. Chronic
 - 2. Tumors
 - i. Fibroma
 - ii. Sarcoma

B. Diseases

I. Skin

- (a) Inflammation
 - 1. Furuncle
 - 2. Carbuncle
 - 3. Acute inflammation
 - 4. Cellulitis
- (b) Anthrax

AFFECTIONS OF THE EXTREMITIES: LEG, ANKLE, FOOT AND TOES

Leg

A. Congenital malformations

- I. Intra-uterine amputation
- II. Congenital furrowing of limb
- III. Congenital curvature of leg
- IV. Absence of tibia or fibula
- V. Rudimentary formation of leg
- VI. Hypertrophy

B. Injuries

- I. Skin and subcutaneous tissues
 - (a) Wounds

- (b) Contusions
- (c) Avulsion

II. Muscles and tendons

- (a) Wounds
- (b) Subcutaneous rupture
 - 1. Plantaris
 - 2. Tendon Achilles

(c) Hernia

(d) Ossification

(e) Dislocation of peroneal tendons

*Leg (Continued)*B. Injuries (*cont.*)

III. Blood-vessels

- (a) Anterior tibial
- (b) Peroneal

IV. Nerves

- (a) Tibial or internal popliteal
- (b) Peroneal or external popliteal
 - 1. Pressure
 - 2. Contusion
 - 3. Laceration

V. Bones

- (a) Fractures of tibia
- (b) Fractures of fibula
- (c) Pott's fracture

C. Affections of soft parts of leg

I. Skin and subcutaneous tissues

- (a) Inflammation
 - 1. Furuncle
 - 2. Carbuncle
 - 3. Lymphangitis
 - 4. Erysipelas
 - 5. Cellulitis
 - 6. Tetanus
- (b) Tuberculosis (lupus)
- (c) Elephantiasis
- (d) Gangrene
 - 1. Diabetic
 - 2. Emphysematous
 - 3. Thrombo-angiitis obliterans
 - 4. Raynaud's symmetrical
 - 5. Traumatic
 - 6. Frost-bite
 - 7. Thrombosis and embolism
 - 8. Pressure (bed-sore)
- (e) Ulcer
 - 1. Varicose
 - 2. Syphilitic
 - 3. Tuberculosis
 - 4. Simple chronic
 - 5. Malignant
- (f) Tumors
 - 1. Any of the benign tumors
 - 2. Occasionally primary epithelioma

- 3. At times carcinoma (secondary)
- 4. Sarcoma

II. Muscles

- (a) Acute myositis
- (b) Abscess
- (c) Myositis ossificans
- (d) Cavernous angioma

III. Blood-vessels

- (a) Aneurysm
- (b) Arteriosclerosis
 - 1. Embolus
 - 2. Thrombus
- (c) Varicose veins
- (d) Acute phlebitis
- (e) Thrombo-angiitis obliterans

IV. Nerves

- (a) Neuritis
 - Sciatica
- (b) Neuroma
 - 1. Benign
 - 2. Malignant

D. Affections of tibia and fibula

I. Inflammations

- (a) Acute periostitis
- (b) Acute osteomyelitis
- (c) Chronic osteomyelitis
- (d) Abscess
- (e) Schlatter's disease

II. Granuloma

- (a) Tuberculosis (of shaft)
- (b) Syphilis
 - 1. Osteochondritis
 - 2. Gummatus osteitis

III. Aneurysm

IV. Rachitic deformities

V. Tumors

- (a) Benign
 - 1. Cyst
 - 2. Exostosis
 - 3. Chondroma
 - 4. Osteoma
- (b) Malignant
 - 1. Sarcoma
 - 2. Carcinoma

Ankle Joint

A. Congenital malformations

- I. Intra-uterine amputations
- II. Congenital dislocations
- III. Club-foot

B. Injuries

- I. Wounds
- II. Contusions
- III. Sprains
- IV. Fractures

C. Diseases

- I. Inflammation

- (a) Acute serous
 - 1. Traumatic
 - 2. Gonorrheal
 - 3. Rheumatic
- (b) Acute purulent
- (c) Chronic serous
 - 1. Gout
 - 2. Arthritis deformans
 - 3. Rheumatic
 - 4. Neuropathic origin
 - 5. Osteomyelitic
 - 6. With flat feet

AFFECTIONS OF THE EXTREMITIES: LEG, ANKLE, FOOT AND TOES (*Continued*)*Ankle Joint (Continued)*C. Diseases (*cont.*)

II. Syphilis

- (a) Chronic serous
- (b) Chronic gummatous

III. Tuberculosis

IV. Tumors

Lipoma

V. Foreign bodies

Foot and Toes

A. Congenital Malformations

- I. Intra-uterine amputation
- II. Club-foot (talipes)
- III. Suppression of digits
- IV. Gigantism
- V. Syndactylism (webbed toes)
- VI. Polydactylism

B. Acquired deformities

- I. Talipes arcuatus
- II. Weak feet
- III. Flat feet
- IV. Hammer-toe
- V. Overlapping toes
- VI. Contracted toes
- VII. Bunion
- VIII. Hallus rigidus
- IX. Spastic paralysis; infantile paralysis

C. Injuries

- I. Skin and subcutaneous tissue
 - (a) Wounds
 - (b) Contusions
 - (c) Avulsion of skin
- II. Muscles
- III. Bones
 - (a) Dislocations
 - (b) Fractures
- IV. Blood-vessels
- V. Nerves

D. Affections of soft tissues of foot and toes

- I. Skin and subcutaneous tissues
 - (a) Inflammation
 - 1. Carbuncle
 - 2. Lymphangitis
 - 3. Cellulitis
 - 4. Erysipelas
 - 5. Emphysematous gangrene
 - 6. Anthrax
 - 7. Actinomycosis
 - 8. Sporotrichosis
 - (b) Granuloma
 - 1. Tuberculosis
 - 2. Syphilis
 - 3. Leprosy
 - (c) Tumors
 - 1. Any of benign tumors
 - 2. Primary epithelioma
 - 3. Sarcoma
 - 4. At times carcinoma, secondary

(d) Corns

(e) Gangrene

- 1. Diabetic
- 2. Emphysematous
- 3. Thrombo-angiitis obliterans
- 4. Raynaud's symmetrical
- 5. Traumatic
- 6. Frost-bite
- 7. Thrombosis and embolism
- 8. Pressure (bed-sore)

(f) Ulcer

- 1. Varicose
- 2. Syphilitic
- 3. Tuberculous
- 4. Simple chronic
- 5. Malignant

II. Muscles

III. Blood-vessels

- (a) Aneurysm
- (b) Thrombosis
- (c) Embolism
- (d) Thrombo-angiitis obliterans
- (e) Intermittent claudication
- (f) Chilblains

IV. Nerves

- (a) Neuritis
- (b) Neuroma
 - 1. Benign
 - 2. Malignant
- (c) Plantar neuralgia
- (d) Metatarsalgia

V. Tendon and tendon sheaths

- (a) Inflammation (tenosynovitis)
 - 1. Pyogenic
 - 2. Gonorrheal
 - 3. Crepitant synovitis (Schaffer's foot)
- (b) Granuloma
 - 1. Tuberculosis
 - 2. Syphilis

VI. Bursa

- (a) Calcaneobursitis (policeman's heel)
- (b) Achillobursitis

VII. Affections about toenails

- (a) Paronychia
- (b) Ingrowing toenail
- (c) Onychia maligna (tuberculosis or malignancy)
- (d) Onychogryposis

AFFECTIONS OF THE EXTREMITIES: LEG, ANKLE, FOOT AND TOES (*Continued*)*Foot and Toes (Continued)*

E. Bones of foot and toes	(a) Acute serous
I. Inflammation	1. Traumatic
(a) Acute periostitis	2. Gonorrheal
(b) Acute osteomyelitis	3. Rheumatic
(c) Abscess	(b) Acute purulent
II. Granulomata	(c) Chronic serous
(a) Tuberculosis	1. Gout
(b) Syphilis	2. Arthritis deformans
1. Osteochondritis	3. Neuropathic origin
2. Gummatous osteitis	II. Syphilis
III. Tumors	(a) Chronic serous
(a) Benign	(b) Chronic gummatous
Exostosis	III. Tuberculosis
(b) Malignant	IV. Tumors
F. Joints of foot and toes	V. Foreign bodies
I. Inflammation	VI. Contractures
	VII. Ankylosis

AFFECTIONS OF THE SHOULDER

Congenital Malformations

Partial or Complete Absence of Clavicle.—When the clavicle, the first bone of the body to ossify, fails to develop from its preëxisting membranes, the condition is often associated with an imperfect development of the membrane-formed bones of the skull, the deformity being called *craniocleidodysostosis*. The greater part of the absent clavicle being represented by a ligamentous cord, the shoulders can be approximated anteriorly and the inner surface of the upper arms can be brought into contact in front of the sternum. If the defect in the clavicle is small, a fracture is imitated.

Elevation of Shoulder (*Sprengel's Deformity*).—This condition may be unilateral or bilateral but always results from some interference with the normal “descensus scapulæ.” It is a rare example of arrest with maldevelopment. The scapula is held in an abnormally high position and the vertebral angle approximated to the midline, so that elevation of the shoulder and abduction of the arm cannot properly be performed. The affected arm is sometimes smaller than the opposite one. There is a tendency for the deformity to become progressively worse toward puberty.

Dislocation of the shoulder is a rare condition but important, because of confusion with traumatic dislocation at birth, obstetrical paralysis, infantile paralysis and separation of the upper epiphysis of the humerus. The arm is held abducted and rotated inward with loss of full motion. X-rays are of little value because of the infantile development of the parts affected. Electrical reactions will differentiate the presence of infantile paralysis.

Injuries

Skin Avulsion.—To have the arm torn away from the body is not an uncommon industrial injury. When the relatively weak clavicle is broken or its ligaments torn away, only muscles hold the upper extremity to the body. These muscles cannot

withstand extreme violence. The seriousness of the injury from the shock of torn nerves and loss of blood can easily be appreciated.

Muscles.—*Incised Wounds.*—These are readily diagnosed, being either partial or complete, and are serious only when important structures in the vicinity are injured at the same time.

Subcutaneous Rupture.—1. Deltoid.—During extreme muscular exertion in abducting the arm, any of the three divisions may be ruptured. In order of frequency of rupture, the deltoid stands fourth among all the muscles of the body. The line of separation may be visible or palpable with swelling on either side due to the belly of the muscle. The hematoma may obliterate the line of separation. The shoulder will appear flattened and abduction of the arm will be impossible. When the arm is passively abducted, the deltoid remains flabby. The deltoid being the strongest abductor of the arm, loss of function of this muscle is very disabling.

2. Pectoralis major may be ruptured under extreme muscular effort or any of its fibers torn from their points of origin. It is the third most frequently ruptured muscle of the body. The general signs will be the same as in any subcutaneous muscular rupture, which are, a visible or palpable line of separation, adjacent swelling, possibly hematoma, flabby muscle and loss of function. Being only one of the muscles concerned in adducting the arm to the chest wall (even though it is the strongest), the pectoralis major can be spared without great inconvenience. This is frequently seen after radical amputation of the breast.

3. Pectoralis minor rupture is not readily diagnosed, the muscle being under cover of the pectoralis major. There is danger in the concomitant rupture of the chief nerves and vessels of the arm, their fibrous investment being adherent to the enveloping fascia of the muscle. After rupture, the scapula falls backward and downward.

4. Coracobrachialis muscle is superficial only below the pectoralis major, hence rupture will usually be concealed by the overlying muscles. The musculocutaneous nerve may be injured as it passes through the muscle. (See chapter on "Peripheral Nerves.") After rupture, the forces holding the head of the humerus in the glenoid fossa lose a strong aid, so that adduction and flexion of the arm at the shoulder are weakened.

5. Subscapularis muscle is deeply situated under the scapula and muscles of the shoulder. On it lie the axillary vessels and brachial plexus which makes any injury to the subscapularis of utmost importance. When it is ruptured, the greatest loss of motion is in medial rotation of the arm.

6. Teres major is also deeply placed and covered by important muscles. When this muscle is ruptured, adduction of the arm is carried out by the latissimus dorsi alone.

7. Biceps muscle rupture is not an infrequent injury. Either head may be affected and the muscle torn at any point, the most common, perhaps, being where the tendon of origin joins the belly of the muscle and where the tendon of insertion is attached to the radius. The usual signs will be present. When the biceps muscle is ruptured, examination discloses two masses separated by a gap. When the tendon of the muscle is ruptured there is but one mass to be seen. If the tendon of the long head is torn within the capsule of the shoulder joint, movements of the shoulder and

repair of the tendon will be more difficult. There will be weakness in flexing the forearm but some motion will be retained if the short head is intact.

8. Trapezius.—Rupture of the trapezius may follow extreme muscular effort, the division taking place at any point in its extensive origin or at its insertion. Usually only a relatively small part of the muscle will be ruptured. A characteristic deformity results, in which the angle and vertebral border of the scapula are prominent, “winged scapula.”

9. Serratus Anterior.—The strong lower portion is seldom injured, rupture being usually confined to the upper two divisions. When the muscle is torn at any point, the scapula falls away from the thoracic wall, to slip backward and medially. Abduction of the arm will be weakened.

Ligaments.—*Incised Wounds.*—Such injuries are usually accompanied by wounds of adjacent important structures. They are diagnosed by inspection after pulling back the edges of the overlying skin wound, by imperfect function, and by partial separation of the bones normally held together by the ligaments, *i.e.*, the scapula, clavicle and humerus.

Subcutaneous Rupture.—1. Acromioclavicular ligament rupture is rare, the fibers normally being somewhat lax and the clavicle usually separating before the ligament gives way. Such an injury follows sudden, severe, backward pressure on the shoulder. Rupture of the coracoclavicular ligament is usually found in the same injury. There will be abnormal mobility of the scapula, while the distal extremity of the clavicle may be found protruding backward on top of the shoulder.

2. Coraco-acromial ligament is very rarely ruptured. Since some fibers of the anterior portion are at times fused with the tendon of the short head of the biceps, they may be injured in rupture of that tendon. In such a case the deltoid muscle is allowed to draw across the capsule of the shoulder joint and the joint is more exposed to injuries directed downward and backward against it.

3. Biceps (Long Tendon).—A rupture may occur at the point of origin from the upper margin of the glenoid cavity, within the capsule of the shoulder joint, or at its junction with the muscle proper. This injury is not uncommon. The point where severe pain is felt at the time of rupture is a good index of the point of separation. There will be loss of function in flexing the forearm and when it is passively flexed, the muscle belly will be soft and flabby, somewhat resembling a lipoma. There may appear to be a slight dislocation of the arm due to the head of the humerus riding upward and forward under the coraco-acromial arch. In severe injury, the tendon may slip from its groove, after rupturing of the transverse ligament which binds it down, and be displaced, usually to the inner side.

4. Coracoclavicular ligament is seldom ruptured, being composed, as it is, of two very strong parts, the conoid and the trapezoid ligaments. The clavicle, as a rule, breaks before these ligaments give way. But in very severe wrenching of the shoulder, such a rupture may occur and is usually associated with rupture of the acromioclavicular ligament also. Hence the same signs will be found; namely, weakness of the shoulder movements with the distal extremity of the clavicle riding above the acromial process.

Blood-Vessels.—See section on “Blood-Vessels.”

Nerves.—See section on “Peripheral Nerve Injuries.”

Joints.—See section on “Bones and Joints.”

Affections of Bursæ

Subacromial.—*Inflammation.*—1. Acute inflammation of the subacromial bursa follows severe trauma or prolonged irritation which allows hemorrhage or effusion to escape into the bursa. This is the most frequently affected of the bursæ about the shoulder joint. The sac of the bursa is usually distended with fluid so that a chronic inflammation of the joint or effusion into the shoulder joint is imitated. There is severe pain limited to the area of the acromium or near the insertion of the deltoid, and which is worse at night. On account of the pain and muscular spasm, abduction and external rotation of the arm are limited or entirely prevented. Radiographic examination is of value in excluding tuberculosis of the head of the humerus and calcareous deposits around the bursa.

2. Acute suppurative inflammation of the subacromial bursa occurs with open wounds or from an hematogenous infection following bruises or prolonged irritation. It is fairly frequent in the course of a chronic bursitis. The pus may travel from the bursa toward the surface, or break the capsule and invade the tissues. The usual signs of inflammation will be present, *i.e.*, pain, heat, swelling, redness, and loss of function. Absence of acute arthritic symptoms will help differentiate an infection of the joint. Loss of function will concern chiefly abduction and external rotation of the arm.

3. Chronic inflammation of the subacromial bursa is probably more common than any other affection of that bursa. Repeated, slight irritation is the causative factor. Effusion into the bursal sac almost always accompanies a chronic inflammation, so that a fluctuant tumor is formed. This will make the deltoid muscle more prominent. There will be a history of prolonged pain in the shoulder, tenderness over the acromial region, and limitation in movements of the arm, especially in abduction. Tenderness will be more marked when the arm is abducted because, then, the bursa is folded up against the greater tuberosity of the humerus.

Hematoma of the subacromial bursa often follows severe blows to the shoulder. The amount of blood escaping is limited only by the size of the bursa and the resulting internal pressure. There will be a fluctuant tumor at the tip of the shoulder, usually with only a slight amount of pain. The bursal wall may give way, allowing the blood to be diffused through the tissues and appear beneath the skin. Hematoma may be differentiated from chronic inflammation with effusion by the history and by aspiration.

Arthritic deposits are very frequently found in the tissues surrounding the subacromial bursa, especially lying under its base and in the tendon of the supraspinatus muscle. This condition often follows chronic irritation; in fact the deposits are generally a part of a chronic inflammation. Deposits of lime salts are thought to often follow tears or bruises of the supraspinatus muscle. They occur especially in people with a gouty diathesis, the lime salt deposits being similar to tophi in the ears. X-rays are of great value. The deposits may give rise to no symptoms or to those that are found in chronic inflammation. When the deposit is in a liquid state it resembles pus, but it is composed of only lime salts, fat cells and débris; suppuration is not present.

Subdeltoid.—*Inflammation.*—1. Acute or spasmodic inflammation follows an acute, severe injury such as a blow on the shoulder. Many writers combine their

descriptions of affections of the subacromial and subdeltoid bursæ because they are so intimately associated and give rise to the same manifestations. The main symptoms are a fluctuant swelling under the deltoid muscle, pain in the tip of the shoulder, tenderness, and limitation of motion, especially in abducting and rotating the arm.

2. Subacute or adherent subdeltoid bursitis follows as a second stage of an acute exudative bursitis. The synovial membrane becomes thickened, adhesions are formed and serum is held in the pockets. Calcareous deposits are found beneath the bursa in the tendons and tendon sheaths. The symptoms are persistent pain in the shoulder, loss of function in moving the arm, atrophy of the deltoid and neuritis of the circumflex nerve. This type of case does not recover spontaneously.

3. Acute suppurative of the subdeltoid bursa has the same etiology as has subacromial bursitis; namely, from within, as an hematogenous infection in the course of simple acute or chronic inflammation, or from without, following open wounds. The usual signs of inflammation will be present. The pus may come to the surface, usually along the anterior edge of the deltoid, or it may break the capsule and spread through the tissues. If infection of the joint were present, more acute arthritic symptoms would be found. The pus must not be confused with arthritic deposits of lime salts in a liquid state.

4. Chronic or non-adherent subdeltoid bursitis follows prolonged irritation to the shoulder region. There is progressive atrophy of the deltoid muscle so that the shoulder appears flattened. The symptoms will be a prolongation of those found in the subacute variety.

Hematoma of the subdeltoid bursa follows severe blows against the point of the shoulder; the condition is similar to the same affection of the subacromial bursa (which see).

Arthritic deposits about the subdeltoid bursa, especially in the supraspinatus and infraspinatus tendons, are rather common. Often they give rise to no symptoms or, at most, to very mild ones. They are generally a part of a chronic inflammation and occur in persons subject to gout and to deposits of lime salts elsewhere in the body.

Tuberculosis (Rice-Body Hygroma).—The subdeltoid bursa may be affected with tuberculosis in two ways. First, a fibrinous deposit may form on the wall, with effusion and fibrinous particles (rice-bodies), loose in the bursa. Secondly, and rarely, the lining membrane may be replaced by tuberculous granulation tissue and the formation of a tuberculous abscess. Either condition may be primary or secondary to tuberculosis of the shoulder joint. The symptoms will be subacute or chronic and difficult to differentiate from simple inflammation. Evidence of active tuberculosis elsewhere in the body leads to a suspicion of the same process in the bursa.

Clavicular.—*Chronic inflammation* of the clavicular bursæ, either of the subclavian, an inconstant one between the fibers of the rhomboid ligament, or of a more common one, the supracoracoid, between the coracoid process and the clavicle and deltoid muscles, will follow prolonged irritation to the shoulder. The condition is commonly found in those who carry heavy weights on the shoulder, or follows a severe, acute strain when adequate rest was not given to the parts, but slight strain was continued. Effusion may occur into the bursa, leading to a tumor visible or palpable on the surface. The symptoms will be tenderness on pressure over the outer

end of the clavicle, fluctuant swelling on top of the shoulder in cases where there is effusion, and pain in the shoulder when any motion is attempted, with resulting limitation of muscular activity.

AFFECTIONS OF AXILLA

(See section "Axilla.")

Affections of the Soft Parts

Inflammations.—*Acute inflammation* of the soft tissues of the shoulder is due to bacterial, non-bacterial, chemical, thermal, and electrical irritants.

Acute suppurative inflammation frequently follows open wounds. If an organism with sufficient virulence causes the infection, the process will be difficult to limit, but will spread through the muscles of the shoulder. The layers of fascia enclosing some of the muscles, such as the supraspinatus, infraspinatus and teres minor, limit the extension of the pus. At times, pus from an acute infection in the joint will break through the capsule and appear between the muscles and beneath the skin, frequently following the bicipital groove to the middle of the arm.

Boils and carbuncles are usually part of the same condition on the neck or back; they are especially painful on the shoulder when irritated by clothing.

Chronic inflammation is not common, and follows the acute processes.

Granulomata.—*Tuberculosis* of the soft parts of the shoulder is an extension of a tuberculosis of bone, usually of the head of the humerus. The abscess which forms appears either anterior or posterior to the deltoid, often following along the bicipital groove.

Actinomycosis may be mistaken for tuberculosis or syphilis. Its primary occurrence in the shoulder is rare; it may be part of a generalized infection or an extension from the neck.

Syphilis (gumma) is very rarely found in this location.

Tumors.—*Benign.*—1. Sebaceous cysts are commonly found on the shoulder. They are easily diagnosed and are of no particular importance.

2. Papillomata are frequent, usually small and give no trouble unless irritated by clothing.

3. Lipomata are very frequently found in the region of the shoulder, especially in association with the deltoid muscle. They may be so loosely attached as to be capable of extensive change in position.

4. Fibromata are not common. At times, a lipoma may have associated with it a fibrous growth, so that the name fibrolipoma is appropriate.

5. Angiomata of all forms are uncommon. Occasionally cavernous hemangiomata, the so-called birth-marks, and cystic lymphangiomata are found on the shoulder. They are subject to irritation, injury and infection.

6. Nevi are frequently found. When simple, pigmented moles, they give no concern. Irritated by clothing or objects carried on the shoulder over a period of years, they may grow to form a melanoma or melanotic sarcoma.

7. Keloids occur in certain predisposed individuals, especially negroes, in the scar of a wound. A small incision or even a healed acne pustule may start the growth. Rarely, the tumor mass may become large.

8. A neuroma in the shoulder region is very rare.

9. Pachydermatocele or plexiform neuroma, a condition in which there is an hypertrophy of the skin and subcutaneous tissues with a tendency of the skin to hang in folds, is an unusual condition. It is made up of soft, fibrocellular tissue in the form of irregular and nodular outgrowths. A form of elephantiasis is produced when the overgrowth becomes extensive.

10. Ossification of the deltoid muscle (shooting bone). As a result of musketry drill, soldiers at times exhibit a completely rigid deltoid muscle, interfering greatly with movements of the arm. There is ossification in the belly of the muscle. Some consider the affection to be a deposition of calcareous salts in an old hematoma; others believe it to be a true, primary bone formation.

11. Chondromata of the soft parts of the shoulder are very uncommon. When they do occur in this region, they are usually connected with one of the bones.

Malignant.—1. Sarcoma may arise from any connective tissue structure of the shoulder and from any fascia or subcutaneous tissue; such an occurrence is rare.

2. Carcinoma appears rarely in the shoulder region as metastatic subcutaneous nodules, the removal of which may aid in the diagnosis of the general malady.

Affections of Bone

(See also chapter on "Bone and Joints.")

Inflammation.—Infections of the bones of the shoulder are relatively uncommon. Their history and course do not differ from the same condition in other bones.

Granulomata.—*Tuberculosis* does not commonly affect the shoulder, but when it does, the disease usually begins in the head of the humerus with extension to the synovial membrane and glenoid cavity. Ankylosis without suppuration, effusion with melon seed bodies or abscess formation may follow.

Syphilis (gumma) of the bones of the shoulder is a rare finding of the tertiary stage. It resembles the same condition appearing in other bones (which see), occurring as a diffuse, chronic osteoperiostitis.

Tumors.—*Benign*.—1. Osteomata are usually found as exostoses, often seeming to have a traumatic origin. They do not differ from osteomata elsewhere.

2. Chondromata are rarely found in the shoulder. At times, small nodules may exist about the epiphyses of the humerus.

Malignant.—1. Osteosarcomata are infrequent in the shoulder proper, but their frequent occurrence in the upper part of the humerus makes their recognition important in this region.

2. Myeloid sarcomata are very uncommon in the shoulder, although the humerus is attacked rarely.

3. Chondrosarcomata are rare.

4. Carcinomata (secondary); attacking the bones of the shoulder, are not infrequently encountered.

Affections of the Scapula

Inflammation.—*Acute periostitis, acute osteitis, acute osteomyelitis, and chronic osteomyelitis* occur in the scapula after exposure to infection and trauma. These

conditions are found most frequently in children and young people. Very often the processes merge into one another and cannot be exactly separated. They resemble the same conditions in other parts, especially in the long bones which are attacked more often than others. These diseases are especially serious when located in the scapula, a bone so closely associated with the lungs and mediastinum.

Granulomata.—*Tuberculosis* of the scapula is not common. When present, caseation occurs with the formation of a cold abscess.

Syphilis (gumma) of the scapula is an unusual finding. It occurs in the tertiary stage with evidence of the disease elsewhere. It prefers first to attack the periosteum and then invades the bone. It may be confused with tuberculosis, but, unlike the latter, usually tends to heal.

Tumors.—*Benign.*—1. Exostoses may occur between any of the points of ossification of the scapula. Since there are nine of these, we may expect exostoses to be fairly common. Of all of the bones, exostoses of the scapula are fourth in frequency. These hypertrophic outgrowths are irregular masses of any size, so small at first as to go undiscovered until they grow of sufficient size to interfere with function. The masses may appear at the seat of an old fracture or at the site of an inflammatory disease of long duration. Carcinomatous changes may occur in any of the exostoses found on the scapula, but they are rare. Cartilaginous exostoses are here infrequent, being more common about the ends of the long bones. A misplaced island of cartilage, trauma and rickets are possible etiologic factors.

2. Osteomata, as distinguished from exostoses by a non-inflammatory origin, derivation from cartilage, and progressive course are not frequently found on the scapula. At times the true nature of the bony deformity is difficult to determine.

3. Fibromata are rare in the scapula.

4. Chondromata are not infrequently found.

Malignant (see chapter on "Tumors").—(1) Osteosarcoma, (2) chondrosarcoma, (3) colloid chondroma, and (4) cystic chondroma may occur anywhere in the body, but are unusual in the scapula. The incidence is less than three-tenths of one per cent.

Affections of Joints

Sternoclavicular.—*Acute inflammation* more often attacks this joint in cases of pyemia, than any other joint. Because the anterior sternoclavicular ligament is weakest, effusion or pus in the joint usually points anteriorly beneath the skin.

Chronic inflammation follows prolonged irritation or lack of rest after dislocation; it is not common.

Tuberculosis rarely attacks the sternoclavicular joint alone. A cold abscess forms subcutaneously.

Neuropathic arthritis occurs in several diseases, but the Charcot's joint of syphilis is the most common. Even this is rare. At times it seems to become activated by a slight injury such as sprain. There is rapid distention of the joint with light-colored serum; dislocation may follow. The process is not painful. The serum may be absorbed and the condition reappear with either atrophy or hypertrophy of the joint.

Acromioclavicular.—*Inflammation*, acute or chronic, of this joint alone is not common. The processes are the same as in other joints.

Tuberculosis is rare, but may be confused with or associated with tuberculosis of the head of the humerus.

Neuropathic arthritis is rare in this location, but similar to the same condition as found in the sternoclavicular joint.

Shoulder.—*Inflammation.*—1. Acute inflammation of the shoulder joint follows minor injuries or occurs in the course of other diseases. The synovial sac of the joint is distended with sterile fluid with extensions along the biceps tendon to the arm, or posteriorly along the subscapularis tendon. There will be a rounded swelling of the shoulder, fluctuation, some subluxation of the joint so that the arm is slightly extended and rotated inwards, with pain and limited motion. The condition must not be confused with acute inflammation of the subacromial bursa.

2. Acute purulent inflammation follows penetrating wounds or extension of an infection from the axilla. The joint may be involved in suppurative epiphysitis of the head of the humerus, since the medial side of the epiphyseal line is within the capsule. There is fever with severe pain on motion of the arm, and swelling of the shoulder. The pus will infiltrate the diverticula of the synovial membrane and find its way either anteriorly into the arm along the bicipital groove or posteriorly into the axilla along the tendon of the subscapularis muscle.

3. Gonorrheal involvement of the shoulder joint is not common. It resembles the same condition found elsewhere. (See chapter on "Bones and Joints.")

4. Chronic inflammation follows prolonged irritation or insufficient, improper treatment of an acute arthritis. There may be a prolonged presence of an effusion, thickening of the synovial membrane or hypertrophy of the villi. Symptoms and signs will depend on the variety of the disease present. In all, there will be a gradual impairment of function.

5. Typhoid arthritis is uncommon in the shoulder. When present, there is often a spontaneous dislocation due to distention of the joint with fluid. The effusion may be sterile, a pure culture of *B. typhosus* found, or the latter mixed with the common pus-forming organisms.

Granuloma.—*Tuberculosis.*—1. Caries sicca is a condition in which tuberculosis has caused an ankylosis of the shoulder joint without suppuration. It is not common, even in children. The head of the humerus is usually primarily affected, with extension to the synovial membrane and glenoid fossa. The arm is shortened, while the head of the humerus may be palpated in an abnormal position.

2. This type is, in all respects, similar to tuberculosis found in other joints.

Acute articular rheumatism frequently attacks the shoulder joint in its traveling involvement of the joints of the body. The symptoms and signs of both the childhood and adult forms are fully described in the chapter on "Bones and Joints."

Neuropathic arthritis, the most frequently encountered form of which is Charcot's disease, is occasionally noted in the shoulder, in the tertiary stage of syphilis. It is the third most frequently involved joint in this condition. After some slight trauma, there is a sudden painless effusion into the joint with resulting increased mobility or even dislocation. Eventually there follows either atrophy and erosion or hypertrophy of the ends of the bones entering into the formation of the joint.

Contractures of the shoulder joint follow immobilization necessitated by injuries, fractures or infections of the arm. Proper early management will prevent most

of them from appearing. There may be some pain on pressure over the joint, with marked loss of abduction and circumduction of the arm. No difficulty is found in adduction or weight carrying. More severe contractures occur when muscles or ligaments have been damaged by injury or infection.

Ankylosis may be fibrous or osseous, that is, either incomplete or complete. The first follows severe arthritis of any nature; the second occurs when the shoulder joint is destroyed either accidentally or surgically. In the latter condition, there is a true bony union of the opposing surfaces. Due to the free movements of the scapula and clavicle, a surprising amount of use can be made of the arm if the ankylosis is in the proper position, which is with the humerus at about right angle abduction to the body with some flexion and internal rotation. In this position the hand can reach the mouth and head.

Arthritis deformans frequently attacks the shoulder joint either in its hypertrophic or atrophic form. The clinical types are: (1) Chronic monarticular variety, occurring chiefly in elderly people with crepitus, pain, stiffness and increasing limitation of motion; (2) chronic polyarticular variety, occurring especially in middle-aged females, in which there is an extension from the phalangeal articulations; and (3) acute polyarticular variety, in young persons, appearing suddenly with a febrile attack and which may slowly progress from the small joints of the hand or feet, involving, in its course, the shoulder. All forms have pain, tenderness, gradual impairment of motion of the arm and enlargement of the ends of the bones with perhaps resulting ankylosis and contractures.

Flail joint of the shoulder follows loss of bone directly from extensive wounds or secondarily from infection. There is marked functional impairment due, not only to loss of bone, but to absence of a fulcrum for the lever, the humerus.

Papillary synovitis is not frequently encountered in the shoulder. There is hypertrophy of the villi of the synovial membrane which may be caught during motions of the arm, giving painful symptoms.

AFFECTIONS OF THE UPPER ARM

Congenital Malformations

Abrachia is a condition in which there is an absence of the arms.

Monobrachia is a congenital defect in which there is an absence of one arm.

Perobrachia is characterized by a rudimentary formation of arms; occasionally encountered, but rare. All these defects are usually associated with other congenital defects, *i.e.*, club-feet, absence of toes, spina bifida and the like.

"Spontaneous amputation" is a congenital malformation, due to the failure of development of the distal portion of an arm from any point which has been constricted by an intra-uterine band. It is not common.

Hypertrophy is a rare affection, characterized by an oversize of both arms, or of one arm, or of a portion of an arm.

Injuries

Skin and Subcutaneous Tissue.—*Wounds of an incised nature* may be of any size, either superficial or deep. If superficial, they are unimportant if repaired,

and heal without infection. If deep, they are serious to the extent to which blood-vessels, nerves and muscles are injured or infection occurs.

Contusions are usually slight. When severe, important structures may be injured or the bone crushed.

Avulsion of the skin may occur to any degree.

Muscles.—Wounds of muscle are easily diagnosed by inspection and by observation of loss of function. The greatest danger is in infection or injury to blood-vessels or nerves.

Subcutaneous Rupture.—1. The biceps muscle may be ruptured on severe exertion. The point of separation may occur where the tendon arises from the supraglenoid tuberosity or where it attaches itself to the muscle proper. At times, the tendon slips from the bicipital groove. There will be pain at the point of rupture with a firm swelling in the belly of the muscle. A definite ridge is usually noted. On passive flexion of the arm, the swelling will remain. Active flexion of the forearm will be weakened or impossible.

2. The coracobrachialis muscle may be ruptured, but such an accident is not common. There will be weakness in adducting and flexing the arm and slight subluxation of the head of the humerus.

3. The triceps muscle is ruptured occasionally, but not as frequently as the biceps. If the olecranon process is not fractured, any one of the three heads or, more commonly, the tendon of insertion may be severed. There will be difficulty in extending the forearm with a firm swelling remaining when the arm is passively extended.

Hernia.—A hernia of either the biceps or triceps muscle occurs when there is a congenital absence or weakness of part of the muscular fascia. There will be a soft protrusion of part of the muscle belly which will flatten out and disappear when the muscle contracts. This distinguishes hernia from rupture of the muscle. Gun-shot wounds, extensive lacerations, etc., may bring about the condition.

Ossification of the muscles of the arm occurs after injury, especially following contusion or laceration of muscle with prolonged irritation. The bony formation will be in the muscle proper, with no abnormal attachment to the underlying bone. There will be a gradual impairment of function. The true nature of the condition is easily shown by radiography.

Blood-Vessels.—*Brachial.*—Injuries to the brachial artery or its branches may follow any wound of the arm. Such injuries are not uncommon, but happily most of them are not extensive or serious. Important nerves, *i.e.*, radial and ulnar, are usually injured at the same time. If severe, there may be a complete shutting off of the blood to the forearm with resulting gangrene. A false aneurysm or secondary hemorrhage may follow.

Nerves (see chapter on "Peripheral Nerve Injuries").—The *musculospiral nerve*, the most frequently injured nerve in the arm, may be injured by pressure, contusion, or laceration. It is commonly compressed in the callus of a fractured humerus. A characteristic deformity, wrist-drop, is produced by loss of function of the extensors of the wrist and fingers.

2. The *median nerve* is rarely injured alone. There will be inability to pronate the hand, flex the fingers, or adduct the thumb to the tips of the fingers. The atrophy of the thenar eminence makes the name "ape-hand" appropriate. Sensory

losses may be slight, due to the extensive distribution of the ulnar and radial nerves; it is most marked on the distal extremities of the first and second fingers.

3. The *ulnar nerve* is seldom injured alone, in the arm. The characteristic claw-hand deformity is produced with anesthesia of the fifth finger.

Affections of the Soft Parts

Skin and Subcutaneous Tissues.—*Inflammation.*—(1) Furuncle and (2) carbuncle are not unusual in this region. (3) Lymphangitis is secondary to infections of the fingers and hand; therefore it is common. It manifests itself by swelling of the lymph-nodes, tenderness, and some interference with motion. When the distal infection is appropriately treated, the lymphangitis usually subsides without further difficulty.

4. Erysipelas frequently follows wounds of the arm. There will be an elevation of temperature with general malaise. The process will show a definite raised, swollen border with a crimson-red, shining surface. Extending peripherally, it may involve the whole arm and advance to the body.

5. Cellulitis is an infection of the loose subcutaneous tissues of the arm, often following a small wound. There will be all the signs of an acute inflammation.

6. Emphysematous gangrene follows infection of a wound by the gas bacillus. There is a firm, edematous swelling of the skin, a distinct bronze hue and formation of gas with crepitation on palpation. A pronounced and almost characteristic odor is present. The process is rapid in its course and very often fatal.

Tuberculosis (lupus) is rarely found on the skin of the arm. It begins as red papules, developing into tubercles and then into indolent ulcers which are shallow, have a small secretion and tend to bleed when irritated.

Tumors.—1. Any of the benign tumors may be found in the soft tissues of the arm. Those most frequently present are neuromata, neurofibromata, cavernous angiomatica or traumatic osteomata.

2. Primary epitheliomata are rarely found on the arm.

3. Carcinoma in the form of small, subcutaneous, metastatic nodules may appear secondarily to a malignant tumor elsewhere in the body. The removal and microscopic study of the metastatic growth will often aid in the diagnosis of the deep-seated involvement.

Muscles.—*Acute myositis* is common following contusions or lacerations. The muscles are infiltrated, rigid, tender and painful on attempted motion. The process goes on to resolution.

Abscess of the muscle follows either penetrating wounds with infection or extension from neighboring infectious processes of the hand or bone. All the signs of inflammation will be present. If the infection is controlled and adequate drainage instituted, the greatest disability will come from cicatricial deformity.

Myositis Ossificans.—See section on "Muscles."

Cavernous angioma is not common in the arm muscles, but it must always be considered for differential purposes in diagnosing tumors of the arm. This type of tumor will be rendered immovable on muscular contraction, can often be emptied by pressure or elevation of the arm, is usually of long duration in its growth, and is often accompanied by acute swelling.

Syphilis attacks the muscles in the tertiary stage, as a diffuse sclerosis or in the form of a localized gumma. The history, slow growth, hardness and improvement under antisyphilitic treatment and the positive Wassermann will establish a diagnosis.

Blood-Vessels.—*Aneurysm* may be primary (true) or traumatic (true or false). The latter is fairly common in the brachial artery after penetrating wounds.

Cirroid aneurysm (congenital) is uncommon in the arm, but resembles the same condition found most frequently in the scalp.

Arteriosclerosis or an endocardial lesion are usually etiologic factors in the formation of a thrombosis or embolism.

1. Thrombosis is not common in the brachial artery or its branches.

2. Embolism is fairly frequent, occurring especially in cases of vegetative endocarditis. A sudden, severe pain will be felt at the seat of lodgment of the embolus. Distally the arm will grow cold and pale, with signs of approaching gangrene.

Nerves.—*Neuritis* of the nerves of the arm is fairly common and sometimes follows an injury. There is pain in the entire arm, often more severe along one nerve trunk (disturbances of sensation and tenderness whenever the affected nerve can be compressed). More commonly, only the medial, radial or ulnar nerves are attacked.

Neuromata and *neurofibromata* in the arm are sufficiently common only to be considered in a differential diagnosis. Any nerve tumor may undergo malignant changes, of either sarcomatous or myxosarcomatous degeneration. Both are rare in the arm and have the same prognosis as such malignancy elsewhere.

Bursa.—*Olecranon.*—1. Acute inflammation may follow an acute or prolonged irritation, or open wounds. In the simple variety there will be a distention of the bursa with clear fluid; when infected, the fluid will be displaced by pus. The soft tissues about the elbow and the underlying bone are early involved if free drainage is not instituted. The joint is rarely involved.

2. Chronic inflammation follows slight irritation over the point of the elbow for a protracted period of time. It is sometimes called *miner's elbow*. The sac of the bursa will be distended with clear fluid. There will be pain and impaired motion.

3. Tuberculosis of the olecranon bursa is rare. There may be a fibrinous deposit on the serous membrane with effusion and many loose, fibrous bodies.

Lymph Glands (*Cubital*).—*Acute inflammation* of the cubital lymph-nodes is usually secondary to an infectious process in the fingers, hand or forearm.

Chronic inflammation may be simple, syphilitic or tuberculous. The simple variety is due to peripheral irritation, not sufficiently severe to cause an acute attack. The glands are enlarged, painful, tender but not adherent.

Hyperplasia of the cubital lymph-nodes may be part of a general enlargement of nodes through the body, occurring chiefly in children. The nodes will be rounded, regular, freely movable and not tender.

In *lymphatic leukemia*, the enlargement will be regular, freely movable and always discrete. There will be no pain or tendency to suppuration. Enlargement of other nodes, spleen and the blood-picture will make the diagnosis.

Hodgkin's disease attacks the cubital lymph-nodes only late in its course. The nodes will be enlarged, not tender, at first discrete, but later adherent to each other. They will not suppurate. Microscopic sections will complete the diagnosis.

Tuberculosis is fairly common. It is a chronic process and slowly progressive. The nodes at the elbow will be enlarged, not tender, will tend to coalesce and to break down as caseation ensues.

Actinomycosis is rare, but may be secondary to the same type of infection on the hand or forearm.

Syphilis may attack the cubital lymph-nodes in any of the three stages: Primary, as in drainage from a chancre on the fingers or hand; secondary, in generalized lymph-node enlargement, at which time the *epitrochlears* usually become involved; tertiary, as a gummatous change or in drainage from a broken-down gumma. The nodes will be discrete, firm, freely movable, without tenderness or a tendency to suppuration.

Lymphosarcoma is uncommon in the region of the elbow. The glands are at first firm, free and painless; later, they become densely adherent and painful from implication of nerves. The overlying skin takes on a bluish hue and finally ulceration and sloughing follow. Metastasis occurs early and the course is rapid.

Carcinoma is not common in the cubital nodes, which will be involved when the primary growth is distal to them. The glands will be very hard, not tender, adherent and may coalesce, but will not break down.

Affections of Humerus

Inflammations.—*Acute periostitis*, *acute osteomyelitis*, and *chronic osteomyelitis* are fairly common in the humerus. Any one of them may follow severe injury. Occasionally a slight trauma may bring about the condition. Signs and symptoms of severe infection may be present. For full discussion see chapter on "Bones and Joints."

At times an *acute pyogenic infection* may limit itself to *abscess formation*. This may be due to a low virulence of the causative organism. There will be signs of a localized infection of the bone, *i.e.*, fever, tenderness and perhaps some swelling.

Granulomata.—*Tuberculosis* of the shaft may occur either beneath the periosteum or in the cancellous tissue. Both are frequently encountered, especially in children. Caseation and suppuration occur with discharge of a characteristic pus. The process resembles chronic osteomyelitis, though radiographic and bacteriologic examination will differentiate the condition.

Syphilis attacks the humerus rarely, either as (1) an osteochondritis or (2) a gummatous osteitis. Both are found in the tertiary stage. Caries may result, but the sequestrum may not be separated for a long period. All syphilitic bone processes are usually of a very indolent nature. Other signs of tertiary syphilis will be present.

Aneurysm of the humerus, also called blood-cyst, is of a doubtful etiology. The condition is rare and may first give evidence of its existence by a spontaneous fracture. There is a medullary swelling of the shaft, the cortex is markedly thinned out and the contents blood. Some consider it a tumor formation; others, an inflammatory process.

Echinococcus cyst is a very rare affection of the humerus. A spontaneous fracture may be the first sign. The bone becomes expanded, simulating a new growth. The diagnosis is not likely to be made.

Rachitic deformities are fairly common in the humerus. Due to the softened condition, the bones may bend in various directions, tending to increase their natural curves and be drawn out of shape by the strong muscles attached to them. Growth is often checked by the disease.

Tumors.—Benign.—1. Simple cysts are fairly frequent in the upper end of the humerus, but their presence is usually not suspected until a spontaneous fracture occurs. They may be mistaken for sarcoma.

2. Exostoses are not uncommonly found at the epiphyseal ends of the humerus or along the shaft at the insertion of tendons. They are smooth, flat, dense, usually multiple, and do not often increase in size after adult life. They may interfere with nerves or tendons overlying them.

3. Chondromata are occasionally encountered, growing slowly at the ends of the humerus.

4. Osteomata, as contrasted with exostoses, are not common.

Malignant.—1. Sarcomata are fairly frequent, growing especially in the proximal end of the humerus. There is a gradual, painless enlargement of the upper arm. The exact diagnosis of sarcoma is often difficult to make and the type of sarcoma, (a) cystic, (b) chondro-, (c) myxo-, or (d) osteo-, is all the more difficult without exploratory incision.

2. Carcinoma of the humerus is always secondary, *i.e.*, by metastasis or extension. Spontaneous fracture may occur. This process is not as common here as in the femur.

AFFECTIONS OF THE ELBOW JOINT PROPER

Congenital Anomalies

Phocomelus, “seal-baby,” is a fetus with hands and feet but without arms or legs.

Hemimelus is a fetus with defective, shortened limbs and is a rare congenital malformation.

Congenital deformities associated with laxity of the ligaments of the elbow give rise to:

Cubital varus in which the forearm is adducted at the elbow.

Cubitus valgus, a condition in which it is abducted; they are not common.

Congenital dislocation of the radius and ulna are not frequently encountered.

Dislocation of the ulna alone is one of the rarest findings.

Dislocation of the radius is more common. In the latter condition, the forearm will be partially pronated while extension, further pronation and supination will be limited in range.

Injuries

Wounds of the elbow joint are serious when important structures, *i.e.*, nerves or blood-vessels, are severed, or when infection is present. If suppurative arthritis or osteitis occurs, ankylosis may result.

Contusions, when severe, may be accompanied by a crushing fracture.

Sprains of the elbow are very common, but this diagnosis should be made only after a most careful examination rules out a more serious lesion.

Pulled elbow is the name given to a downward subluxation of the radial head. It occurs chiefly in children under four years of age and is the result of forcibly pulling on the extremity, as in lifting a child by the arm after it has fallen. The arm will be pronated and slightly flexed, while the child cries with pain. The displacement is easily overcome.

Diseases

Inflammations.—*Acute inflammation* follows contusions, bruises or sprains. The joint will be painful, distended with clear fluid, movements will be limited and the arm carried slightly flexed. Complete resolution usually ensues, but there may be some residual impairment of mobility. Gonorrhea seldom attacks the elbow joint; when it does, a simple acute inflammation is imitated, but the process is liable to be more painful, more severe and runs a more protracted course. Rheumatism commonly affects the elbow as it travels from one joint to another. It resembles a simple, acute inflammation, usually ending in resolution.

Acute purulent inflammation follows penetrating wounds, occasionally in the course of the acute infectious diseases and in generalized infections. The joint will be swollen, hot and carried slightly flexed, the position in which the joint capacity is greatest, and therefore can best accommodate a quantity of pus. If the pus is not drained early, involvement of the bones follows with serious impairment of function. Constitutional symptoms are usually pronounced.

Chronic inflammation of the elbow occurs in a number of diseased conditions. In gout, involvement may occur but is not common. Arthritis deformans may affect the elbow in elderly people, especially after an injury; such a condition involves other joints. Chronic inflammation may have a neuropathic origin, the most common form being a *Charcot's joint* in the tertiary stage of syphilis. After a slight injury, there will be a sudden effusion into the joint, so great that dislocation is not uncommon. The elbow is not a frequent seat of election in this condition. Ankylosis of the joint occasionally follows.

Granulomata.—*Tuberculosis* is a common affection of the elbow joint, occurring chiefly in children. The synovial membrane is first attacked with marked thickening, so that a bulge is found on either side of the olecranon and biceps tendon. The entire elbow will be swollen into a spindle-form shape. There will be pain, tenderness, limitation of motion and later, atrophy of the muscles. Caseation and abscess formation follow.

Syphilis attacks the elbow joint in the tertiary stage, either as a chronic, serous synovitis or as a chronic, gummatous inflammation. There is but little pain while the changes in the joint are of great variety, following no definite rule. There may be marked loss of function.

Tumors.—*Lipomata* are occasionally found within the elbow joint especially in those cases in which there has been a rupture of the synovial membrane. Occasionally, the fat in a synovial fringe may form a lipoma. There may be signs of distention of the joint and pain when the lipoma is caught between the ends of the bone.

Foreign bodies enter the joint during injury. At times a lipoma or bits of synovial fringe act as foreign bodies. They may cause a simple inflammation and interfere with motion of the joint.

AFFECTIONS OF THE SOFT TISSUES OF ELBOW

Injuries

Wounds of the soft tissues of the elbow are very common. Most of them affecting the skin are of little importance. When a deep wound is inflicted and infection ensues, the tissues become greatly swollen; extension to the arm or joint may follow. Severe lacerations of the soft tissues frequently complicate elbow fractures. The most serious muscle injury is a division of the tendon of insertion of the biceps or triceps. Being deeply situated, the arteries of the elbow region are not as frequently injured as they are in the lower parts of the extremity; a deep, incised wound is, however, likely to reach one of them. Severe hemorrhage or a traumatic aneurysm is a frequent result. The three principal nerves, radial, ulnar and median, are also deeply placed and are injured only by deep wounds. The consequences of their injury are discussed in the chapter on "Peripheral Nerve Injuries."

Contracture of the elbow may follow wounds of the biceps or spasm of that muscle after the arm has been kept for some time in a splint or sling. There may be inability to extend the arm which will be very resistive to treatment.

Diseases

Skin.—*Inflammations.*—Furuncle and carbuncle are fairly frequent about the elbow and forearm but require no special description.

Acute inflammation is usually a phlegmon, secondary to infection of the fingers, hand or forearm.

Cellulitis is common following infected wounds.

Chronic inflammation is not frequent except as of tuberculous or syphilitic origin.

Anthrax is occasionally seen in the region of the elbow in workers of leather, butchers or woolsorters. The first sign is a painful papule which becomes the center of an intense inflammation. The papule becomes a pustular bleb and gives way to a depressed, gangrenous area, while the surrounding skin is edematous and hard. Marked general symptoms with high fever are present. Death results in about one-third of the cases.

Tuberculosis of the soft parts of the elbow follows caries, lupus or infection of the tendon sheaths in the distal part of the extremity. There is swelling while the skin and subcutaneous tissue are infiltrated with pus, forming a true tuberculous lymphangitis and abscess. Persons affected in this way have a low resistance and often show signs of tuberculosis elsewhere.

Tumors in the region of the elbow may be the lipoma, fibroma, osteoma, sarcoma and occasionally epithelioma. They are uncommon in this location.

Bursa (*Olecranon*).—See under "Upper Arm," just described.

Tendon Sheaths.—See "Diseases of Tendon Sheaths."

Blood-Vessels.—1. As the result of penetrating wounds an aneurysm may form in the vessels of this location.

2. The most common affection of the blood-vessels of the elbow region, apart from injury, is perhaps embolism. The point of division of the relatively large

brachial artery into the radial and ulnar is a favorite seat of lodgment for an embolus. There will be severe pain at the point of arrest while the limb below will grow pale and cold, signs of approaching gangrene ensuing.

3. Thrombosis of the superficial veins frequently follows repeated blood transfusions. The deep veins of the arm are seldom involved in thrombosis.

Nerves.—Neuritis of one of the three main nerves of the elbow region is not infrequent. It follows prolonged pressure, blows or hypodermic injections. See “Nerves of Upper Arm.”

AFFECTIONS OF THE FOREARM

Congenital Malformations

Spontaneous amputation is a condition of congenital origin and is often termed intra-uterine amputation.

Rudimentary formation may occur.

Hypertrophy may occur.

Absence of the radius is of interest but fortunately is a rare condition. It is more often unilateral and right-sided, while the forearm is atrophied and shortened and the ulna and the hand are deviated toward the radial side; a portion of the radial side of the hand is often lacking, such as the thumb, first or second fingers. Congenital absence of the *ulna* is an extremely uncommon condition. In this deformity there is a deviation of the hand toward the ulnar side and the third, fourth and fifth fingers may be missing.

Congenital pronation of the forearm is more often bilateral and often accompanies fusion of the upper portions of the radius and ulna. The arm is held in a state of complete or partial pronation, and supination, at times, is impossible.

Injuries

Skin and Subcutaneous Tissue.—*Wounds* in this location are common and may be of all types and varieties. They are essentially the same as those found in other parts. Deep lacerations involving the muscles of the forearm are often attended with wounds of the nerves; as in other extremities, the danger of infection is always present. The surgeon should always be on his guard against the possible existence of a gas bacillus infection.

Contusions of the forearm are common and are distinguished, as a rule, by swelling, a sense of tightness or of pain and by the appearance of ecchymosis.

Avulsion of the skin in this location is infrequent but may occur following severe trauma.

Muscles.—*Wounds* of the muscles are of all varieties as found in muscles elsewhere in the body and complete severance of tendons or muscle proper are at times demonstrated by an impairment of function of various movements of the hand and wrist.

Subcutaneous rupture is uncommon though severe muscle traumatism exerted either on the hand or elbow has caused it. There is often present over the site of rupture a depression both visible and palpable or signs of hemorrhage about the muscle tearing.

Hernia of the muscles of the forearm is demonstrated by a soft, more or less boggy swelling which can, on pressure, be reduced but which recurs upon the release of the pressure.

Ossification of the muscles of the forearm is an extremely rare condition but has been known to follow severe strains with intra- and extra-muscular and ligamentous hemorrhage.

Blood-Vessels.—Injuries of the blood-vessels are important, not only from the standpoint of hemorrhage, but from the possibility of the subsequent development of an aneurysm which may be mistaken for a tumor or an abscess. The aneurysm may be a true or a false one; the latter due to a blood-clot cavity adjacent to a lacerated vessel. They are not as common in practice as following war wounds.

Nerves.—See chapter on "Peripheral Nerve Injuries."

Amputation Neuroma.—See chapter on "Tumors."

Bones.—Injuries to the forearm bones are common, the vast percentage of them being fractures. See chapter on "Fractures and Dislocations." At times, the posterior aspects of both the ulna and radius are traumatized by an indirect blow following which there may be periosteal enlargement, which may ultimately lead to an osteomyelitis. The anterior portions of the bones are rarely bruised, due to the deep-seated position and to their protective but muscular structures.

Affections of the Soft Parts

Skin and Subcutaneous Tissue.—*Inflammation* of the soft parts of the forearm follows infected wounds of the fingers, hand and forearm or some infection of the fingers or hand. It should be borne in mind that wounds or abrasions of the hand or fingers which give but little local trouble may at times give rise to the most serious of infections of the forearm. See chapter on "Infection, Gangrene and Ulcers."

Tuberculosis.—1. Lupus is an extremely rare condition in this location and manifests itself by the typical serpiginous ulcer.

2. The metastatic tubercle is, at first, impossible to diagnose clinically. The condition first manifests itself by a small nodule, somewhat painful on pressure. As the lesion progresses, abscess formation occurs with, eventually, sinus formation from which pus containing tubercle bacilli exudes.

3. Lymphangitis may be of a tuberculous origin and is distinguished by a thickening of the lymphatics of the forearm. If present without a secondary infection there is no, or but little, constitutional reaction. The lymphatics in this condition show a sluggish induration of the surrounding tissue.

Tumors of the forearm are fairly common and for the most part include the benign ones, especially the lipoma, fibroma, and sebaceous cyst. Occasionally the cavernous angioma is encountered and may simulate in many respects a tuberculous or ordinary pyogenic abscess; the main distinguishing feature being an increased swelling when the arm is held down and its disappearance when raised, or upon pressure.

1. Primary epitheliomata of the forearm are extremely rare but may follow a prolonged chronic irritation.

2. Carcinoma is more often secondary in this location and, as a rule, follows a carcinoma of the hand.

Muscles.—See chapter on “Muscles.”

Blood-Vessels.—An aneurysm in this location is rare, a penetrating wound, as a rule, being the etiologic cause. It is diagnosed by a pulsating swelling in the course of the ulnar or radial artery together with other signs pathognomonic of aneurysm. It must be distinguished, at times, from a spindle-shaped tumor which does not pulsate but does lie in the course of a nerve, and which is usually a neuroma or neurofibroma. See chapter on “Arteries, Veins and Lymphatics.”

Nerves.—See chapter on “Peripheral Nerve Injuries.”

Affections of the Bones

These are similar to those described elsewhere. The conditions which present the greatest diagnostic difficulty are tuberculosis, gumma, osteomyelitis and sarcoma. In children, the diaphysis is frequently attacked by tuberculosis which is readily confused with chronic osteomyelitis; a radiographic examination and examination of the pus usually differentiate the condition. See chapter on “Bones and Joints.”

AFFECTIONS OF WRIST JOINT

Congenital Malformations

Simple dislocation is of frequent occurrence and is diagnosed by the visible deformity.

Club-hand (*manus vara*) corresponds to club-foot of the lower extremity and is a rare congenital anomaly.

Injuries

Injuries to the wrist are common. Most of them are simple lacerations or sprains. It is often impossible to ascertain whether there is a sprain or fracture of one of the small bones, until a radiographic examination has been made. Swelling, deformity, pain and impairment of function are the usual signs of severe sprains of the wrist and these simulate, in many respects, fractures. Dislocations of the wrist are not common. Colles' fracture is of frequent occurrence. See chapter on “Fractures and Dislocations.”

Diseases

(See chapter on “Bones and Joints.”)

AFFECTIONS OF THE SOFT TISSUES ABOUT WRIST

Injuries

Injuries about the wrist are of importance because of the frequent involvement of the radial and ulnar vessels together with the various ligaments in their vicinity. Due to the quick contraction of the ends of the tendons following injury,

the clinical signs manifested by the fingers and hand proper must aid as a guide in the speculation as to the exact tendons involved. For injuries of the nerves, see chapter on "Peripheral Nerve Injuries."

Contracture of the wrist follows nerve, tendon and blood-vessel injuries and may be of a markedly deforming nature.

Diseases

Inflammations about the soft tissues are frequent and usually secondary to infected wounds of the hand. Involvement of tendons and tendon sheaths must always be considered when there appears to be interference with normal finger movements. On the other hand, when there appears impairment of function of the joint itself, extension of the inflammation to the joint must be considered. See chapter on "Infections."

Tumors in this location are not common and for the most part are of the benign variety, the lipoma, fibroma and sebaceous cyst being most frequently found.

Tendon and Tendon Sheaths (see chapter on "Tendons").—Swelling is exhibited in *tuberculosis* of the tendon sheath about the wrist, and generally presents, not in the wrist itself where the anterior carpal ligament binds down the tendons, but either above or below that area. In these cases, movements of the wrist are limited only by the mechanical interference of the swelling. Pressure on the joint is not painful.

Of special note in this location is the formation of the so-called *ganglion*, which so often follows an acute injury or chronic strain of the tendon. This cystic change within the tendon sheath may form a large tumor mass most common over the dorsal aspect of the wrist. As a rule, the tumor is about the size of a hazelnut but varies considerably in its extent. It is elastic and semifluctuant, fairly freely movable and not attached to the skin. It may or may not be sensitive on pressure. At times, it is found as a large flattened mass occupying the whole of the anterior aspect of the wrist. In this type of case it represents an extensive involvement of the tendons. Due to its invasion in and about the tendons, impairment of function of the hand and wrist is often present; at times, definite contractures of the finger follow an extensive invasion of the wrist ligaments. It is of frequent occurrence.

Blood-Vessels.—See chapter on "Arteries, Veins and Lymphatics."

Nerves.—See chapter on "Peripheral Nerve Injuries."

AFFECTIONS OF HAND AND FINGERS

Congenital Malformations

Ectrodactyl (*absence of fingers*) is not uncommon and is often associated with a deformity elsewhere in the body. Heredity seems to be an etiologic factor.

Polydactyl (*supernumerary fingers*) is fairly common. Any finger may be duplicated, an additional thumb or fifth finger being the most frequently found. The extra fingers are usually not fully developed and the metacarpal bone is, as a rule, absent. The same condition is often found in the toes of the same indi-

vidual. *Suppression* of fingers may occur either in number or length of any digit.

Brachydactyl is a condition in which any finger is abnormally short. When the central fingers are missing, the condition is known as claw or cleft hand.

Macroductyl or hypertrophy of the fingers may occur as an enlargement of all the tissues of only the soft parts, or as additional fingers.

Syndactyl (*web fingers*) is fairly common and is the result of failure of normal development; it is often on an hereditary basis. The fingers on the outer side of the hand are usually affected, the union being thin or dense and involving a variable length of the digits.

Congenital contraction of the finger (hammer-finger) may occur in association with hammer-toes. The fifth finger is most commonly affected. Usually there are no contraction bands in any direction as in Dupuytren's contracture.

Acquired Deformities

Madelung's spontaneous subluxation of the wrist should be considered as an occupational deformity occurring especially in washerwomen and pianists. It consists of a subluxation of the radial ulnar joint and a definite separation of the ulna from the bones of the wrist. The affection may begin in early adult life and progressively extend for about two years, after which time the deformity is often completely established. In the early stages, pain is often pronounced, but this passes away as the condition becomes older. There is a marked thickening of the wrist when flexed laterally; on the dorsal aspect, the lower ends of the radius and ulna are prominent, while from the palmar surface, the upper row of the bones of the wrist stand out. When fairly recent, the deformity is readily reduced, the ulna is pushed down to the level of the radius; recurrence is very liable to take place.

Dupuytren's contracture of the palmar fascia is a condition found chiefly after middle age in men who have used their palms in work. The third, fourth and second fingers in order of frequency are affected. It should be borne in mind, however, that occupational trauma is not the etiologic factor. A definite contracture following an injury or infection, may present the same condition. The metacarpophalangeal joints are affected in such a manner that the fingers are drawn down toward the palm and then the second and first interphalangeal joints become involved. The condition is really a contraction of the fascia, the tendons being only secondarily involved. Early symptoms are a sense of tightness in the palm, with neuralgic pain. Later on, the skin over the affected region becomes thickened and adherent; inability to fully extend the fingers increases. The condition is steadily progressive. It must not be confused with congenital contracture of the fingers, contractures due to nerve lesions in the forearm, adherent tendons, or osteo-arthritis.

Trigger-finger is a condition in which, after flexion of all the fingers, on an attempt at extension the involved finger remains flexed until passively extended when it straightens out with a snap. The condition occurs usually in adults who have been doing some unusual manual labor, a rheumatic diathesis often being present. Conditions which may give rise to this condition are thick-

ening of a tendon, narrowing of the tendon sheath, bands of fibrous tissue, exostoses of the metacarpal head, tumors or ganglia. The condition is readily diagnosed.

Mallet-finger is a rare affection in which there is an inability to extend the terminal phalanx following an injury, at which time the tip was flexed while the finger was in firm extension.

Volkman's ischemic contracture follows a fracture of the forearm or humerus in which the splint or bandage has been applied so tightly as to partially shut off the blood supply. There follows an hyperextension of the wrist with a flexion or clawing of the fingers. A spreading myositis fibrosa occasionally occurs.

Osteo-arthritis is rather commonly found and especially affects the small joints of the hand. The chronic polyarticular variety occurs chiefly in women of middle life, the distal interphalangeal joints being first involved: Stiffness, swelling and tenderness are present. The fingers are partially flexed or otherwise distorted so that the patient may be quite helpless. The condition is usually a steadily progressive one. The acute polyarticular type occurs mainly in young females and often follows some acute infection. The onset is accompanied by fever and an increased pulse rate. The smaller joints of the hands and feet are first attacked with accompanying symptoms and signs of pain, stiffness and a variable degree of joint effusion. Deformities of the fingers occur; especially ulnar adduction. The disease is slowly progressive but may be arrested by suitable treatment. Numerous deformities of the hands occur in this condition.

Adhesions of tendons to their sheaths follow lacerations, burns and infections, and give rise to variable degrees of tendon contractures.

Nerve lesions give rise to deformities of the hand and briefly may be described as follows:

(a) In syringomyelia there may be trophic disturbances, glossy skin, hypertrophic nails, eruptions and chronic ulcerations. Perforating ulcers may occur without pain and there may be present mutilation and even loss of the phalanges.

(b) In Raynaud's disease, the fingers may appear pale and bloodless and when pricked with a pin there may be no escape of blood. There is a tingling and numbness in the fingers involved. After a period lasting from a few minutes to a few hours the condition may pass away or a cyanotic appearance of the affected parts develops. In exceptional cases a definite gangrene ensues. In the acute stages there are generally the symptoms of nausea, general malaise and chills.

(c) In Klumpke's paralysis there is a paralysis of the small muscles of the hand and wrist, with pain extending along the forearm into the fingers; anesthesia over the region of the ulnar nerve is present.

Injuries

Injuries to the hand are the most common lesions requiring surgical treatment. Happily, most of them are so small as to give no trouble and none offer special difficulties in diagnosis.

Affections of the Soft Parts of the Hand

Skin and Subcutaneous Tissues.—*Any inflammation* of the soft parts of the hand may be encountered. Lymphangitis or cellulitis following some small

abrasion of the skin are the conditions most frequently found. The wound itself often gives no trouble or concern beyond looking slightly inflamed, but after two or three days there are signs of an inflammation extending up the arm. The hand and arm become swollen, reddened, hot and painful. There may be small red lines running up the arm: an acute inflammation of the lymphatics. The lymphatic glands in the axilla will be enlarged and tender. Unless treated, the condition may assume a serious aspect. Other infections of the hand are furuncle, carbuncle, erysipelas, emphysematous gangrene and anthrax. See chapter on "Infections."

Granulomata.—Actinomycosis, tuberculosis and chancre of the hand occur. See chapter on "Infections."

Tumors of the hand are fairly common and are of a great variety:

1. Benign.—(a) Simple warts are of everyday occurrence and recognized by everyone. They are of importance only in the differentiation from more serious conditions.

(b) Sebaceous cysts are, as a rule, on the dorsum of the hand, while epithelial cysts occur in the palm following displacement of some epithelial cells into the deeper layers.

(c) Lipomata are usually on the palmar surface but they may appear between the metacarpal bones on the dorsum. They are always limited above by the carpal ligament, in contrast to tuberculosis of the tendon sheath.

(d) Fibromata, (e) angiomata and (f) chondromata present their usual characteristics. See chapter on "Tumors."

2. Malignant.—(a) Epithelioma as a rule appears on the dorsum: It presents first, as a flat, warty growth, later on ulcerating and discharging a thin serosanguineous fluid.

(b) Sarcoma and (c) secondary carcinoma. See chapter on "Tumors."

Affections of the muscles of the hand are uncommon except as complications of other conditions. See accompanying chart.

Blood-Vessels.—See accompanying chart.

Nerves.—For affections of the nerves of the upper extremity causing important disabilities of the hand and fingers, see chapter on "Peripheral Nerve Injuries."

Tendons and Tendon Sheaths.—*Inflammation (Tenosynovitis)*.—1. Pyogenic inflammation of the tendons and tendon sheaths follows penetrating wounds with infection. This is a subject of great importance. The inflammation extends rapidly along the sheath; if occurring in the thumb, early involvement of the little finger may appear because of the frequent communication between the two, in the palm. There will be present all the signs of inflammation with pain on pressure over the involved tendon and perhaps later on, fluctuation.

2. Gonorrheal inflammation occasionally follows in the wake of a specific urethritis and presents a subacute type of tenosynovitis.

3. Crepitant tenosynovitis occurs especially in laborers and is manifested by a painful swelling over the extensor tendon or tendons; the thumb is, as a rule, involved. Crepitation in the affected region is often noted on movement of the fingers.

1. Contracting tenosynovitis is the result of a constriction of the tendon by

its sheath; here, too, the thumb is generally involved. Pain radiating toward the thumb with tenderness on pressure over the involved tendons is significant of this affection.

Granulomata.—1. Tuberculosis of the tendon sheath is very often responsible for a persistent chronic inflammatory condition of the tendons. It occasionally follows infected wounds secondarily infected by the tubercle bacillus; its origin may be hematogenous. There is a soft swelling along the tendon sheath and inability to normally flex the finger. Extension may take place to the wrist, from which the tendons of all of the fingers may become involved. If there is a fluid accumulation within the sheath it may be displaced upwards to the forearm.

2. Syphilitic tenosynovitis is rare in this location and is in no way characteristic. A chronic, more or less indurated tenosynovitis in the presence of syphilis is suggestive.

Finger Nail.—*Inflammations* about the finger nails are called “whitlows,” “felons” or “paronychiæ.” The infection usually starts in a “hangnail.” The pus, primarily, forms just beneath the epidermis, gradually extends deeper into the underlying tissues and at times involves the bone. All the symptoms and signs of inflammation are present; pain is especially severe. When a whitlow does not clear up rapidly under treatment or several occur in a short time, we must be certain that some underlying condition, such as diabetes, is not present.

Granulomata.—Primary Chancre of the Finger.—This, too, occurs around the margin of the nail, but does not progress so as to ever involve the hand. The ulcer forms slowly and the characteristic induration is present. During the secondary stage an involvement of the nail bed, termed paronychia syphilitica, may occur.

Affections of the Bones of the Hand and Fingers

Inflammation of the bones of the hand and fingers is usually secondary to an infected wound in this region. Often bone involvement occurs without an extensive or severe infection. Osteomyelitis of the phalanges is recognized by swelling and tenderness of the entire circumference; pain on pressure; and if the disease has extended sufficiently, false mobility of the finger. In chronic osteomyelitis the signs and symptoms are those of a sluggish inflammatory condition involving the superficial tissues as well as the bone. See chapter on “Bones and Joints.” Radiographic examination confirms the diagnosis.

Granulomata.—*Tuberculosis* of the phalanges manifests itself by a chronic spindle-shaped swelling with little pain and a tendency to suppurate and form a sinus. The disease may begin in either the medullary cavity or the periosteum. The condition can easily be mistaken for a syphilitic lesion. Differentiation can be made only by the tendency of tuberculosis toward suppuration and by the absence of a syphilitic history, negative Wassermann reaction and response to antisyphilitic treatment.

Tumors of the bones of the hand are usually *chondromata* or *exostoses*. Occasionally there will be found a *sarcoma* which may be confused for a long time with a benign enlargement. Often microscopic examination will be necessary to diagnose the lesion. The benign tumors are fairly common on and may considerably deform the hand.

Affections of the Joints of Hand and Fingers

Inflammation of the joints of the hand and fingers (see chapter on "Bones and Joints") usually follows infection of a wound with involvement of bone, muscle or tendons. The first interphalangeal joint is most often attacked. It shows all the evidences of inflammation with spindle-shaped swelling. As a rule the disease of the joint is secondary to infection of contiguous structures and its symptoms are overshadowed by the primary condition. Eventually cartilage will be destroyed and crepitus can be elicited. *Gout*, in the hand, usually attacks the metacarpophalangeal joint of the thumb. The onset is sudden, extremely painful and with redness and swelling about the joint. After days, the acute stage passes, leaving the joint tender and swollen. "Tophi" may be found about the smaller articulations of the hand, as they are in the ears. The overlying skin may break down, allowing a chalky discharge to escape. The chronic polyarticular variety of osteo-arthritis most frequently attacks the small joints of the hands in adult females.

Syphilis.—See chapter on "Bones and Joints."

Tuberculosis of the joints of the hand and fingers is not as common as it is in other joints.

Tumors are of such infrequent occurrence as to make discussion here unnecessary. See chapter on "Tumors."

Foreign bodies in the joint are of great surgical importance. They are diagnosed by the history, pain on motion and by radiography. An old foreign body may give rise to suppuration or stiffness.

Contractures and ankylosis of the fingers are important, but offer no serious difficulties in diagnosis.

AFFECTIONS OF THE HIP JOINT

Congenital Malformations

Congenital Dislocations.—See chapter on "Fractures and Dislocations."

Congenital coxa vara is a condition most frequently confused with congenital dislocation of the hip; the neck of the femur is shortened and the angle with the shaft is decreased, at times, to a right angle. There is lordosis and a waddling gait with elevation of the trochanters as in dislocation, but in coxa vara motion of the thigh is usually restricted and the opposite of "Trendelenburg's sign of dislocation" is found; namely, when the patient stands on the affected leg the sound side of the pelvis is raised. Radiography will clear up a doubtful diagnosis. Congenital coxa vara may occur alone, but it is more frequently associated with congenital dislocation of the hip. It is rare in either case.

Coxa valga is a condition characterized by an abnormal elevation of the neck of the femur. It is, essentially, a very rare congenital anomaly. The limb is rotated outward and abducted, causing an awkward gait.

Injuries

Minor injuries of the hip are common but present little diagnostic difficulty. Traumatic dislocations of the hip are of extreme importance but fortunately are

rare and comprise only about 2 per cent of all dislocations. For signs and symptoms, see chapter on "Fractures and Dislocations."

Diseases

Inflammation.—*Acute serous inflammation* may be either (1) gonorrheal or, (2) "rheumatic" in origin; these are uncommon. (3) Typhoid arthritis most frequently attacks the hip but is now rarely noted, owing to the infrequency of typhoid fever. Without consideration of the etiologic organism, the joint becomes painful, swollen and temporary impairment of function is present. Occasionally a purulent arthritis follows.

Acute purulent infection of the hip follows wounds, an extension of an infection from the pelvis, from an osteomyelitis of the pelvic bones, or from an acute osteomyelitis of the head and neck of the femur. The affection occasionally follows an acute serous inflammation. It, too, occurs in the presence of a general infection or as occasionally happens, it may be primarily infected from an hematogenous origin. The thin central portion of the acetabulum offers little resistance to the spread of infection in either direction. Abscess formation may follow.

Chronic pyogenic infection of the hip is uncommon.

1. Gout rarely attacks the hip joint. If present, other signs of gout appear.
2. A monarticular type of osteo-arthritis exists. The etiology is unknown but often trauma seems to be responsible for the condition. Radiographs show proliferative changes about the edge of the acetabulum and roughening of the head of the femur.
3. See sections on "Neuropathic Origin."
4. Perthes' disease is a condition characterized by a disturbance in the nutrition of the head of the femur and occurs in children. It may be mistaken for early tuberculosis. There is but slight functional disturbance, or little muscular atrophy. The head assumes a mushroom-like deformity. The mild symptoms subside and only a small amount of shortening is usually found. Clinically, a characteristic radiograph always remains.

Syphilis is not frequently encountered in this location. At times, a Charcot's joint with great serous distention of the joint-capsule occurs. Spontaneous dislocation is possible.

Tuberculosis of the hip is discussed in the chapter on "Bones and Joints."

Tumors.—Lipomata within the joint have been found. They are of rare occurrence. At times they give rise to pain and impairment of function.

Foreign bodies are occasionally found following extensive wounds.

AFFECTIONS OF THE THIGH

Congenital Malformations

These are not common but several varieties have been described. An intra-uterine amputation, absence of one or both femurs and shortening or furrowing occasionally occur.

Osteogenesis imperfecta is properly a symptom of many diseases; the bones fracture repeatedly after slight trauma and readily unite. Such injuries even occur before birth. Heredity is thought to be a strong causative factor.

Cretinism is a condition in which there is a failure of development of the bones so that a dwarf with very small extremities is produced. Surgically it is important only in differential diagnosis.

In **achondroplasia** the legs are only about half their normal length.

Spastic paralysis or cerebral palsy of childhood leads to deformities only as the muscles and tendons draw the feet and legs away from their normal positions.

Injuries

Skin and Subcutaneous Tissue.—Injuries are common.

Muscles.—*Wounds* are common.

Subcutaneous rupture of a thigh muscle is frequently encountered.

1. The quadriceps femoris muscle usually ruptures in its most distal portion or in the ligamentum patellæ. For description see under "Soft Tissues about Knee."

2. Rupture of the sartorius has been reported. See chapter on "Muscles, Tendons and Bursæ."

3. Rupture of the adductor longus often occurs in workmen who suddenly attempt to regain a standing posture while employed in an exaggerated straddling position. In all these ruptures there will be a history of severe strain, sudden, sharp pain at the point of rupture, a soft relaxed muscle belly on an attempt to use the muscles and a gap between the severed ends.

A *muscle hernia* in this location, as elsewhere, is characterized by a soft elastic bulging, disappearing on pressure, and recurring on release of pressure.

Ossification.—See chapter on "Muscles, Tendons and Bursæ."

Blood-vessels of the thigh are not infrequently injured. Stab or bullet wounds are the most common causes and the consequences may be mild or dangerous, depending upon the size of the vessel destroyed.

Injuries to the nerves are uncommon. See chapter on "Peripheral Nerve Injuries."

Fracture of the femur is a common injury, occurring at any age or in any portion of the bone, most frequently in the middle third, from direct or indirect violence. The distal end is usually drawn upward and inward by the action of the hamstrings and adductors. The diagnosis is not difficult. There is the history of injury, loss of active motion, shortening, severe pain at the point of fracture, palpable evidence of separation, abnormal passive mobility and eversion of the foot with slight flexion of the knee. See chapter on "Fractures and Dislocations."

Affections of Soft Parts

Skin and Subcutaneous Tissue.—*Inflammation.*—The inflammatory conditions, in this location, are either primary or secondary: (1) Furuncle, (2) carbuncle and (3) erysipelas show the same signs and symptoms as like affections elsewhere in the body. The inguinal lymph glands are usually affected. (4) Lymphan-

gitis follows infections in the leg or foot, or is secondary to infected wounds. For (5) cellulitis and (6) emphysematous gangrene, see chapter on "Infections, Gangrene and Ulcers."

Tuberculosis (Lupus).—See "Infections, Gangrene and Ulcers."

Any of the *tumors* mentioned in the accompanying chart may be present though the fibroma, lipoma and sarcoma are the most common. For description see chapter on "Tumors."

Muscles.—Tuberculous and gummatous nodules, angiomatica and ossification are the most frequent affections found. The ossification of the adductor muscles, known as "riders' bone," was at one time of a not infrequent occurrence.

Blood-Vessels.—*Post-traumatic aneurysms* are frequently encountered; they are diagnosed by the position, pulsation and vascular condition distal to the injured joint. A true aneurysm must not be confused with a recent arterial hematoma.

Arteriosclerosis.—The large vessels of the thigh are not frequently involved in either (1) thrombosis or (2) embolism. See chapter on "Infections, Gangrene and Ulcers."

Phlegmasia alba dolens (milk-leg) is commonly found in severe infections of the pelvis or in the septicemias. It may follow operations on the pelvic viscera, parturition or typhoid fever. It is more common in the left leg with symptoms of pain, tenderness, swelling with marked edema and rise of temperature.

Nerves.—*Sciatica* is a frequent affection of the nerves of the thigh. Many conditions of the thigh are loosely termed sciatica but true sciatica has a definite group of symptoms. It occurs chiefly in men, following injury to the lower back, or from exposure to wet and cold. At times, no cause can even be assigned to it. The chief symptoms are pain in the lower buttock and down the leg with tenderness over the course of the sciatic, *i.e.*, posterior iliac spine region, middle or posterior thigh, midpopliteal region, behind the external malleolus and often to the heel.

A differential diagnosis must be made from hip joint or spinal cord disease. It occasionally follows a true sacro-iliac strain and is often caused by pressure from malignant tumors.

Affections of the inguinal nodes closely correspond to the same conditions as are found in the axilla. See chapter on "Arteries, Veins and Lymphatics."

Affections of Femur

(See chapter on "Bones and Joints.")

AFFECTIONS OF THE KNEE JOINT PROPER

Congenital Malformations

Congenital malformations of the knee are rare. **Genu recurvatum** (a curvature of knee joint, backward) is associated with **absence of the patella** or with **posterior dislocation of the tibia and fibula**.

Injuries

Injuries are frequently found. A sprain usually follows an indirect injury such as excessive adduction, abduction or rotation. There will be interference with motion and some effusion and tenderness over the lateral ligaments. With signs of injury such as an abrasion of the skin and tenderness over the part struck or injured, a contusion of the knee joint can be diagnosed. With this condition the lateral ligaments will not be involved. See Differential Chart, "Swelling of Knee Joint." See also chapters on "Fractures and Dislocations" and "Bones and Joints."

Diseases

Inflammation.—*Acute serous synovitis* represents a reaction on the part of the synovium of the knee joint, to conditions of a traumatic origin, presence of foreign bodies, inflammatory conditions such as gonorrhea and so-called rheumatism and to villous arthritis.

1. Traumatic synovitis follows acute injury and is recognized by a serous effusion of the joint proper. Pain is a variable factor and impairment of motion is, at times, marked, owing to the intra-articular fluid.

2. A foreign body in the joint may give rise to the same type of symptoms as is found in the traumatic type. The foreign body is a portion of a floating cartilage.

3. Gonorrhea frequently affects the knee and simulates a chronic synovitis except that it is more painful, more severe and more persistent. Usually only one joint is involved, and this occurs during about the third week of the urethritis. In even the last stages aspirated pus is usually found to be sterile. If a mixed infection occurs, the symptoms are more severe.

4. "Acute rheumatism" of the knee joint is usually part of a general infection in which multiple joints are involved. The joint is swollen, extremely tender, hot and often red; the joint cavity is so distended as to cause the leg to lie semi-flexed on its external surface. In this condition endocardial changes are likely to be noted and signs of sepsis may be present. The joint, as a rule, does not assume the purulent nature though, from external evidences, it simulates an acute purulent joint.

5. Villous Arthritis.—See chapter on "Affections of Bones and Joints."

Acute purulent inflammation of the knee joint is one of the most serious of surgical conditions. Etiologically it may follow acute knee trauma or it may be a complication of a general blood infection. At times, the disease is limited to the one joint itself. In this condition the joint is, as a rule, markedly swollen, hot, fluctuant and painful, and the leg lies in a semiflexed position and on its external surface. Signs of sepsis are present and the offending organisms are often to be found by blood culture. See chapter on "Affections of Bones and Joints."

Chronic Inflammation.—See chapter on "Affections of Bones and Joints."

Syphilis.—See chapter on "Affections of Bones and Joints."

Tuberculosis.—See chapter on "Affections of Bones and Joints."

Tumors.—See chapter on "Affections of Bones and Joints;"

Foreign Bodies.—See chapter on “Affections of Bones and Joints.”

Intermittent Hydrops.—See Differential Chart, “Joint Swellings.”

AFFECTIONS OF THE SOFT TISSUES ABOUT KNEE

Injuries

Wounds.—Wounds involving the *skin and subcutaneous tissue* are of the same varieties as found elsewhere in the body. Lacerations in this area are, however, prone to involve the joint and the greatest care possible should be taken before one rules out an involvement of the knee joint.

Injuries to the *muscles* are generally of the bruising type and are not as severe or as commonly encountered as are injuries to the quadriceps tendon or patellar ligaments.

Laceration of the *quadriceps tendon* is fairly rare but gives a characteristic palpable and visible hollow proximal to the patella. It usually occurs in heavy individuals following unusual exertion but seldom follows direct trauma. Forward muscular movements of the affected leg are usually completely lost. Detachment of the *ligamentum patellæ* is common, following either direct or indirect injuries. Under ordinary conditions, a sulcus is not as pronounced as in rupture of the quadriceps tendon; the patient, at times, will be able to lift his leg somewhat from the ground and to walk with a moderate amount of weight-bearing on the affected leg.

Blood-Vessels.—1. The popliteal vessels and their branches are occasionally injured following crushing or gunshot wounds. If there is a definite wound, the usual signs of hemorrhage are present, though in severe crushing injuries without skin laceration, a fluctuant and boggy mass situated behind the joint and covered with ecchymotic skin presents. It represents subcutaneous and intramuscular hemorrhage.

Nerves.—See chapter on “Peripheral Nerve Injuries.”

Contracture of Knee.—Contracture of the knee often follows severe trauma, burns, and immobility over a long period of time.

Diseases

Skin.—See chapter on “Affections of Bones and Joints.”

Bursæ.—*Prepatellar bursitis* or housemaid’s knee is a common affection following a chronic irritation caused by kneeling. The swelling is in front of the patella and does not involve the joint or popliteal space. It may vary in size from that of an almond to that of a large orange. It is, as a rule, semifluctuant and tender to the touch and, at times, the inflammatory condition leads to ulcerative changes over the mass. If the bursa is persistent and of the ulcerative type, a tuberculosis must be considered.

Occasionally other bursæ about the knee, such as the *pretibial* and *suprapatellar*, become inflamed and give symptoms similar to a prepatellar bursitis, the difference in location being an important factor in arriving at a diagnosis.

Tendon Sheaths.—See “Diseases of Tendon Sheaths.”

Blood-Vessels.—See “Affections of Arteries, Veins and Lymphatics.”

AFFECTIONS OF THE LEG

Congenital Malformations

See appended chart. These anomalies are rare and their diagnosis can be made upon inspection.

Injuries

Skin and Subcutaneous Tissues.—*Wounds and contusions* in this location are of most frequent occurrence and there is no difficulty in forming a diagnosis.

Avulsion of the skin is a fairly rare condition and follows extreme degrees of trauma.

Muscles and Tendons.—*Wounds* of the muscles and tendons are commonly found in this location and usually present no difficulty in diagnosis.

Subcutaneous Rupture.—1. Rupture of the plantar fascia occasionally is a complication of fractures or dislocations of the bones of the foot and leg. The disability as shown by this condition usually demonstrates itself in a partial dropping of the anteroposterior arch of the foot with the production of the signs and symptoms of flat-foot.

2. Rupture of the *tendo achillis* is usually produced by violent or unusual exertion accompanied by an actual strain upon the tendon. In this location it occurs probably with the greatest of frequency in tennis players. In this affection there may be a definite grooving at the side of separation of rupture, though more often a portion of the os calcis at the side of insertion of the tendon is torn away. This is especially true if there has been a direct trauma to the bone in the presence of extreme muscular effort. There is a complete or partial loss of power of plantar flexion in the foot and an inability to stand upon the toes on the affected side. At the point of insertion of the tendon with the os calcis there may be noted a deep sulcus.

Hernia of the muscles of the leg is demonstrated by a soft, somewhat elastic swelling in the course of one or more muscles of the leg which reduces upon pressure and which returns upon pressure release. It is of common occurrence.

Ossification is more common in the quadriceps extensor tendon than in any tendon of the leg, while the adductor longus muscle, following repeated trauma, is often affected. This condition is known as "riders' bone." See chapter on "Surgical Affections of Muscles, Tendons and Bursæ."

Dislocation of peroneal tendons is an infrequent complication of muscular effort. The occurrence is indicated by severe pain and a snapping sensation, and the tendon is usually found in an abnormal position over the malleolus with the corresponding depression in the usual anatomic situation. Dislocation of this tendon is often habitual and in some individuals may be produced voluntarily as well as actually.

Blood-Vessels.—Anterior tibial and peroneal vessels are often lacerated and completely torn following extensive leg injuries. The extent of necrosis following depends on the amount of vascular damage.

Nerves.—See chapter on "Peripheral Nerve Injuries."

Bones.—See chapter on "Fractures and Dislocations."

Affections of Soft Parts

Skin and Subcutaneous Tissues.—*Inflammation.*—Infection usually follows infected wounds of the foot or toes and is similar to corresponding lesions in other regions, for which see the chapter on “Infections.”

Lupus of the leg is similar in all respects to a tuberculous skin lesion found in other locations.

Elephantiasis of the leg is not common. It results from a chronic blocking of the lymph-channels, generally by any of the following conditions: *Filaria sanguinis hominis*, tuberculosis or malignancy, adhesions and inflammatory tissue about the lymphatics and any lesion from without, causing extreme pressure. Surgical removal of the inguinal glands has often been a contributing factor.

Gangrene.—This condition is of extreme frequency in the leg and is due to a number of underlying conditions. See chapter on “Infections, Gangrene and Ulcers.”

1. Diabetic gangrene, as a rule, occurs in chronic cases and in those of over forty years of age and often follows slight injury or infection. It often appears primarily under one of the toes and spreads rapidly or slowly, eventually involving a portion of the foot and leg.

2. Empysematous gangrene is caused by the bacillus of malignant edema or by the *Bacillus aerogenes capsulatus*. It is usually a rapidly fatal complication following some extensive deep injury, such as in compound fracture or in those conditions in which there has been a vast amount of tearing of the tissue. After about two days' incubation period, the region becomes of a purplish hue, gangrenous and has a characteristic odor. Bubbles and gas can easily be expressed from the wound and can be felt over the surrounding skin. The tissues for a goodly distance above the primary area of infection show the same crepitation. Rapid and extensive infiltration of the tissues, at times very far removed from the original focus, is characteristic of the disease. Severe toxemia develops and the patient often dies within forty-eight hours.

3. Gangrene following *thrombo-angiitis obliterans* is supposed to occur more especially in Russian Jews than in any other individuals. Statistics, however, vary on this point. Sensory and trophic disturbances occur in the leg followed by a gangrene beginning in the toe and extending upwards. For a full discussion see chapter on “Affections of Arteries, Veins and Lymphatics.”

4. Raynaud's symmetric gangrene is often found in neurotic young women and is due to a vasomotor spasm. At first there is local anemia followed by congestion and necrosis. The condition is often painful and, if extensive, gangrene results.

5. Traumatic gangrene follows an injury in which the blood supply is cut off from the involved region. The part is cold, pulseless, cyanotic, and gradually becomes gangrenous.

6. In frost-bite, gangrene is the result of exposure to the cold. The toes are frequently affected, at first being pale and hot, and later becoming shrunken and black; eventually they may separate from the healthy tissue.

7. The occurrence of thrombosis and embolism in this location is common. Thrombosis generally comes on gradually, while embolism is of sudden onset, accompanied by very severe pain at the point of lodgment of the embolus, which

is usually in the popliteal space. See chapter on "Affections of Arteries, Veins and Lymphatics."

8. Pressure gangrene or bed-sore occurs in patients of weakened resistance who have been for a long period of time in bed and in one position. The part under pressure becomes red, inflamed, ulcerates and gangrene of the surrounding parts follows. The process is not usually deep but extension to the bone may occur. When it appears in the aged it may assume extremely serious proportions.

Ulcers (see chapter on "Infections, Gangrene and Ulcers").—1. Varicose ulcers of the leg are of very frequent occurrence and there is but little difficulty in the forming of a diagnosis. It should be borne in mind, however, that extensive varicosities of the neighboring veins may not be demonstrated until the patient assumes a certain position. There is often the history of injury with small abrasion. The part affected is congested and the ulcer is of an indolent nature, usually painless and on the lower internal surface of the leg.

2. Syphilitic ulcers are usually multiple and punched out in appearance. They often follow a painless cutaneous gumma.

3. Tuberculous ulcers of the leg are not common. They have the same characteristics as lupus.

4. Simple chronic ulcers appear in middle life and are usually caused by lack of medical treatment. They often follow injury. The surface is usually smooth, shiny and of a dirty yellow color with serous or purulent discharge.

5. Malignant ulcers are due to replacement of skin by the new growth. The edges are usually characteristically undermined, the floor roughened and a sero-sanguineous discharge present. It is of the utmost importance that, in all suspicious ulcers, a microscopic examination of a portion of the edge be made. A clinical diagnosis of malignant ulcer will frequently not be formed until the glands in the groin have become involved.

Tumors.—Any of the benign or malignant tumors may occur in the soft tissues of the leg but they are rare.

Muscles.—See chapter on "Affections of Muscles and Tendons."

Blood-Vessels.—See chapter on "Affections of Arteries, Veins and Lymphatics."

Affections of the Tibia and Fibula

(See "Affections of Bones and Joints.")

AFFECTIONS OF THE ANKLE JOINT

Congenital Malformations

Of congenital malformations of the ankle, *club-foot* is the most common. It is classified as to the position of the foot in the relation to the axis of the leg. There are talipes equinus, or plantar flexion, calcaneus or dorsiflexion, varus or adduction and inversion, valgus or abduction and eversion. Any combination of these may be present, the most frequent deformity of all being a talipes equinovarus. This is easily recognized. The foot is turned downward and inward, the sole facing either inward or even almost upward.

Injuries

Injuries to the ankle joint are common, presenting diagnostic signs as found elsewhere in the body.

Sprains occur far more frequently than fractures. There is a history of injury, swelling, tenderness and limitation of motion. As a result, the symptoms of sprain are not as severe as those of fracture, but often radiographic examination is necessary to arrive at a correct diagnosis.

Fractures.—See chapter on “Fractures and Dislocations.”

Diseases

(See chapter on “Affections of Bones and Joints.”)

AFFECTIONS OF THE FOOT AND TOES

Congenital Malformations

Congenital malformations of the foot and toes are not infrequent. There are many cases of deforming malformations of suppression and to any degree. The most common of these conditions is the talipes. See above under “Ankle.” In the foot proper we find pes cavus in which the longitudinal arch is raised or pes planus in which it is lowered. Web toes are occasionally found.

Acquired Deformities

Acquired deformities are numerous.

Talipes arcuatus, or hollow foot, is a form of pes cavus and was frequently found in the late war. Several degrees are recognized. In a moderate degree, the plantar flexors and the tendo achillis are shortened, the arch is increased and there is a dropping of the fore foot. Tenderness is present in the sole along the edge of metatarsal bones. At times, the big toe is a hammer-toe. The deformity is disabling if the patient stands for too long a time.

Weak feet and flat feet are almost universal. The latter is a more marked type of the former. Any degree may be present from the simple pronated foot to the rigid flat foot. The latter is but a more marked type of the former. Faulty fitting shoes or standing with the toes turned out are the main etiologic factors bringing about this condition. Of the early symptoms are a feeling of tiredness in the feet and legs with indefinite pains in the sole and arches, referred to the calf, knee, thigh and back. Irritability of the patient is often most pronounced. A lack of stamina and “general tiredness” are, at times, almost the first complaints. Tenderness may be found on the plantar fascia, especially when it is put on the stretch, below the malleolus and under the heel. There are often painful corns and calluses; sweating is frequent. As the condition progresses, muscle spasm may ensue and the pain, as a rule, is more pronounced, especially when the patient bears weight on the foot and endeavors to walk. Often neuralgic pains are severe even when the patient is entirely at rest. The foot may become reddened and swollen and give all the signs and symptoms of acute inflammation. It should always be borne in mind that

a foot exhibiting the most severe symptoms may, on inspection, show but little of the presence of a fallen arch (during the state of rest). The importance of the recognition of this condition is the inspection of the foot when weight is being borne upon it; it is then that the flatness becomes evident. Backache and pains in the calves of the legs are common.

Plantar neuralgia occurs after long illnesses with subsequent loss of subcutaneous fat of the soles, in flat feet and in rupture of the plantar fascia. It is but a symptom of underlying trouble.

Anterior metatarsalgia is a condition in which there is a weakness of the entire anterior metatarsal arch brought about by flat feet, neuritis or poorly fitting shoes. The chief symptom is severe pain coming on in paroxysms beneath the arch and often extending up the leg.

Morton's neuralgia is a similar spasmodic pain occurring around the head of the fourth metatarsal bone.

Hammer-toe is a frequent deformity in which there is dorsiflexion of the foot on the proximal phalanx and plantar flexion of the second phalanx. The second toe is the one usually involved. Painful corns or bunions may form on the interphalangeal joint.

Overlapping toes and contracted toes offer no difficulties in diagnosis.

Bunion or hallus valgus is characterized by an abduction and prominence of the metatarsophalangeal joint of the big toe. This condition often accompanies a flat foot and the wearing of poorly fitting shoes. The head of the metacarpal bone becomes hypertrophied and is often accompanied by a severe acute inflammation of its overlying bursa.

Hallus rigidus is a painful arthritis of the great toe joint in which the toe is usually held rigidly straight. This condition often accompanies a hallus valgus.

Nerve lesions of the spinal cord or leg often give rise to marked deformities of the feet. Thus we find pes equinus or any form of club-foot, following spastic or infantile paralysis.

Injuries

These are of common occurrence and represent all types as found elsewhere.

Affections of Soft Tissues

Skin and Subcutaneous Tissues.—See appended chart.

Inflammation.—See chapter on "Infections, Gangrene and Ulcers."

Granuloma.—See chapter on "Infections, Gangrene and Ulcers."

Tumors.—See chapter on "Tumors."

Callous formations will, as a rule, follow pressure from poorly fitting shoes. At times, they give rise to severe pain and are the most common of foot affections. Infections following their removal under septic conditions often demand surgical intervention.

Gangrene.—See "Leg."

Ulcers.—See "Leg."

Muscles.—See chapter on "Muscles, Tendons and Bursæ."

Blood-Vessels.—*Aneurysm; Thrombosis; Embolism; Thrombo-Angiitis Obliterans.*—See chapter on "Arteries, Veins and Lymphatics."

Intermittent claudication is a condition frequently found where there is an insufficient blood supply to the foot and leg. The patient is unable to walk for more than a short distance at a time, then forced to rest and then goes on for a few more steps. There are pain and parasthesia in the legs accentuated upon walking. Often there is no pulse found in the dorsalis pedis artery, more rarely in the posterior tibial artery.

Chilblains are the result of severe cold caused by a capillary stasis in the foot and leg with thrombosis and inflammation. An ulcer is often the result. There may be pains in the legs increased by any standing or marked change in the circulation to the part.

Bursa.—*Calcaneobursitis* (policeman's heel) is a painful affection found underneath the heel and caused by an inflammation of a small bursa beneath the os calcis. There is tenderness on pressure over this part and pain and discomfort upon standing.

Achillobursitis is a painful condition due to an inflammation of the bursa between the Achilles tendon and the os calcis. It results from trauma, or in the subacute form, from rheumatism, gout, rickets, or gonorrhea. At the insertion of the tendon there is acute pain which may extend up the leg. The patient often walks on the toes with inversion of the foot. Signs of inflammation may be present in the heel.

Affections about the Toenails.—Affections about the toenails are similar to those about the finger nails.

Paronychia.—See "Finger Nails."

Ingrowing toenails are very commonly found and are usually caused by poorly fitting shoes. The big toe is most especially affected, the soft parts growing up and over the edge of the nail, causing pain and tenderness. Acute inflammation and infection often occur.

Affections of Bones

(See chapter on "Affections of Bones and Joints.")

Affections of Joints

(See chapter on "Bones and Joints.")

CHAPTER X

PERIPHERAL NERVE INJURIES

The recognition and the diagnosis of peripheral nerve lesions, as to the location and the extent of the condition, depend upon two factors; namely, a thorough knowledge of the anatomy of the peripheral nerves and upon the facts deduced from the case history.

Anatomically the peripheral nerves are divided into three groupings: (1) Motor, (2) sensory and (3) motor and sensory. The clinical findings therefore may be a paralysis or paresis of a muscle or muscle group, or, as is most frequent, both sensory and motor disturbances occur simultaneously. The signs and symptoms will depend upon the location and extent of the lesion, upon its nature, and upon the time element and the powers of regeneration. In minor cases the symptoms are entirely subjective and can only be recognized as nerve injuries by a thorough analysis of the case. Imagination and perhaps feigning on the part of the patient may so closely simulate a true nerve lesion as to require care in the differentiation between a functional and an anatomic disturbance.

In obtaining a complete history and record of a case it is best not to prolong the examination for too long a time since the best results can be acquired while the patient is fresh and is willing to coöperate in all respects with the examiner. An accurate mapping out of the areas of anesthesia, paresthesia and analgesia upon charted forms is helpful, and at times essential, and should be carried out as a routine procedure, if possible.

History

Name; Age; Sex; Occupation; Nativity; Date of Examination; Date of Injury

History of Accident.—Traumatic agent, *i.e.*, blow, crush, fall, missile, sharp instrument or muscular effort. Posture of patient and position of limb at time of injury. Type of injury, *i.e.*, contusion, dislocation or fracture (simple or compound), lacerated, incised or penetrating wound. Time of onset of signs and symptoms and whether coincident with injury, or subsequently. Sensations as experienced at time of injury, including pain, type, location and radiation and presence or absence and location of anesthesia or paresthesia. Muscular weakness or paralysis (including rectal and bladder function). Muscular shrinking or atrophy as noted by patient. Progression or retrogression of signs and symptoms as noted by patient. Previous treatment, including operative procedures.

Physical examination should be carried out in a well-lighted room, moderately warm. The examiner should, from time to time, note the facial expression of the patient for signs of pain, fear and restlessness. When examining a limb it should be compared with its fellow of the opposite side.

Inspection.—Signs of previous operations, wounds, cicatrices, swellings, deformities, contractures and signs of an inflammatory reaction in the neighborhood of the above sites. Posture of limb when at rest and when attempts are made at voluntary motion. Signs of paralysis or paresis on attempted voluntary motion. Signs of muscular wasting or atrophy (take measurements on both sides). Muscular spasms or tremors. Vasomotor disturbances and their results. Trophic disturbances.

Palpation.—Carefully palpate along the course of the affected nerve and its surrounding tissue for nodular or boggy swellings. Determine the consistency of the muscles affected by the nerve suspected of being affected, *i.e.*, for spasticity or flaccidity. Reflexes. For any condition of the bones or joints, which might account for the clinical picture, without nerve etiology. Test out the apparently affected limb for voluntary movements and muscular movements with, and without, resistance.

DETERMINATION OF SENSORY DISTURBANCES

Investigation should be carried out in a routine manner with the patient's eyes closed and the following facts regarding sensation of the peripheral nerves should be borne in mind.

There are three groups of sensibility, namely:

1. **Deep Sensibility.**—(*a*) Deep pressure, which, if excessive, causes pressure pain (determined with blunt end of pencil or any other blunt instrument).

(*b*) Joint sensation, which denotes to the patient the position of the joint (determined by passive motion).

(*c*) Kinesthetic sense which denotes to the patient the presence of active muscular contraction.

(*d*) Vibration sense (produced by placing a tuning fork over the subcutaneous surface of a bone or finger nail).

When these tests are positive it shows that the deep sensory fibers are intact even though there is a total anesthesia of the skin over the areas tested.

2. **Protopathic cutaneous sensibility**, which recognizes uncomfortable and painful cutaneous stimuli and extremes of heat and cold (produced by pins and sharp-pointed instrument pricks and by the electric current; also by small test-tubes or other vehicles, containing each, hot and cold water).

"These are the first fibers to regenerate after an injury to a cutaneous nerve."

3. **Epicritic cutaneous sensibility** which recognizes light touches, cutaneous localization and fine differences in temperature (produced by wool or cotton for the light touch and by blunt compasses for cutaneous localization and by test-tubes of water at varying temperatures).

TYPES OF ANESTHESIA IN NERVE INJURIES

Areas of anesthesia in lesions of the sensory or mixed peripheral nerves correspond to the distribution of the affected nerve or nerves. If purely a cutaneous nerve (such as the radial branch of the musculospiral) we have loss of cutaneous sensation, both epicritic and protopathic, while deep sensibility in muscles, tendons and

bones is still preserved. If a mixed trunk be paralyzed (such as the ulnar nerve above elbow) muscular paralysis is superadded to anesthesia, and sensory loss affects not only cutaneous sensibility, but also deep sensation from the corresponding bones, joints and tendons.

In a complete peripheral nerve lesion, the area of cotton-wool anesthesia is always more extensive than the area of analgesia to pin pricks but as we ascend the nerve trunk in a proximal direction, the higher the lesion, the more nearly coterminous do the tactile and pin-prick areas become—until in a posterior root lesion, close to the spinal cord, the area of loss to pin pricks exceeds that of anesthesia to cotton-wool touches. Thus, the nearer the lesion lies to the central nervous system, the more extensive and definite is the loss to pin pricks, and the nearer to the periphery, the greater is the loss to cotton-wool touches.

Where the nerve is not completely severed but merely compressed by scar tissue or callus, etc., areas of cutaneous loss to pin pricks may be more extensive than that of cotton wool loss (Core, *Lancet*, 1916, p. 716).

As a mixed nerve recovers from its paralysis, sensation usually returns before motor power, and protopathic sensation returns before epicritic (Evans and Stewart).

ELECTRICAL REACTIONS

An important phase in the diagnosis and prognosis of peripheral nerve injuries is the testing with both the *faradic* and the *galvanic* current of the various muscles suspected of being involved. It should be remembered, however, that this should be done only in conjunction with a physical examination and the combination of the findings of the two used as a working basis for the diagnosis of the condition.

Injury or disease may bring about the degeneration of the lower motor neurons which in turn, causes a degeneration of the muscle-fibers supplied by the particular nerve involved. As a result, the quick or brisk contraction of the fibrillar element is lost, but the sarcoplasm will sluggishly contract, the fibrillar elements reacting to the faradic current, and the sarcoplasmic elements responding to the galvanic current.

Under normal conditions and with healthy muscles, the cathodal closing contraction is stronger than the anodal closing contraction and the electrical reaction is then KCC-ACC.

In a reaction of degeneration either closing contracture is as strong as the other or the anodal is stronger than the cathodal closing; the former is known as polar equality in which KCC is equal to ACC; in the latter, called polar inversion, the ACC is stronger than KCC.

The sluggish quality of a muscle contraction is of more significance than is the presence of polar changes. The change in response to the galvanic current with an absence of response to the faradic current is called the *reaction of degeneration*.

A sluggish contraction of the muscle to galvanism with a diminution in response to the faradic current is known as *partial reaction of degeneration*.

In *normal muscle* there is a brisk response to the faradic current during the making or closing of the current. There is a brisk response to the galvanic current at the moment of making or breaking, but no contraction of the muscle (unless there is too strong a current) while the current is passing through the muscle.

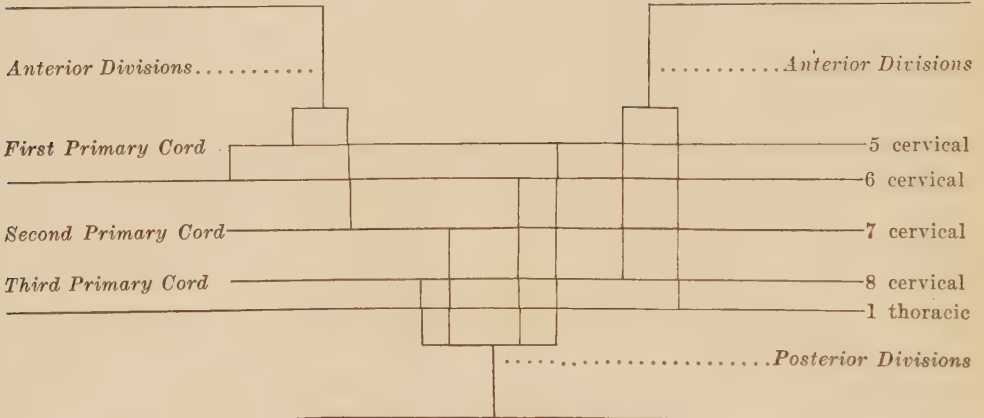
BRACHIAL PLEXUS PARALYSIS

Lesion of Outer Cord

Paralysis of the muscles supplied by the musculocutaneous and median nerves (not including the muscles of hand). Anesthesia along the outer border of forearm.

Lesion of Inner Cord

Loss of sensation along the inner side of arm, forearm and hand. Paralysis of all of the intrinsic muscles of hand, together with paralysis of some or of all the flexors of wrist and fingers (usually only flexor carpi ulnaris and inner half of flexor profundus digitorum).



Lesion of Posterior Cord

Paralysis of the muscles supplied by the circumflex, musculospiral and subscapular nerves.

Anesthesia of the areas supplied by these nerves.

Etiology.—1. *Trauma.*—Direct.—Dislocation or fracture of the shoulder joint at time of accident or as the result of manipulation in replacing the head or fragments, fracture of clavicle, scapula and humerus. Direct violence to the neck or axilla by heavy blows, the constant carrying of heavy weights on neck (especially neck triangles), and wounds of neck or axilla.

Indirect.—Due to overstretching, caused by violence applied remotely from plexus, and which divides itself into two groups: First, in which there is a forced increase of the angle between the head, neck and shoulder of the same side, causing a stretching of the fifth and sixth cervicals, giving rise to *upper arm or Erb-Duchenne paralysis* and frequently encountered in childbirth. Second, those cases caused by a violent increase of angle between arm and thorax, which produces a strain on the eighth cervical, first thoracic and then on the seventh cervical, giving rise to *lower arm or Klumpke paralysis*.

2. *Tumors and Cervical Rib*
3. *Neuritis (Apart from Injury)*
4. *Subclavian or Axillary Aneurysm*
5. *Post Fracture Callus*
6. *Cicatrices (from Muscle Pathology)*

NERVE SUPPLY, MUSCLES OF THE UPPER LIMB (POSTERIOR)

5 Cervical	6 Cervical	7 Cervical	8 Cervical	I Thoracic	Nerve
Levator scapuli					Scapular
Supraspinatus	Supraspinatus				Suprascapular
Infraspinatus	Infraspinatus				Suprascapular
Rhomboideus					Posterior scapular
Rhomboideus					Posterior scapular
Teres minor	Teres minor				Circumflex
Deltoid	Deltoid				Circumflex
	Latissimus dorsi	Latissimus dorsi	Latissimus dorsi		Long scapular
		Triceps	Triceps		Musculospiral
		Anconeus	Anconeus		Musculospiral
	Extensor carpi radialis brevior	Extensor carpi radialis brevior			Posterior interosseous
	Extensor communis digi- torum	Extensor communis digi- torum	Extensor communis digi- torum		Posterior interosseous
	Extensor minimi digiti	Extensor minimi digiti	Extensor minimi digiti		Posterior interosseous
	Supinator brevis				Posterior interosseous
	Extensor carpi ulnaris	Extensor carpi ulnaris	Extensor carpi ulnaris		Posterior interosseous
	Extensor ossis metacarpi pollicis	Extensor ossis metacarpi pollicis	Extensor ossis metacarpi pollicis		Posterior interosseous
	Extensor brevis pollicis	Extensor brevis pollicis	Extensor brevis pollicis		Posterior interosseous
	Extensor longus pollicis	Extensor longus pollicis	Extensor longus pollicis		Posterior interosseous
	Extensor indicis	Extensor indicis	Extensor indicis		Posterior interosseous

Symptoms.—The symptoms depend upon the extent of the lesion. Complete brachial plexus paralysis is extremely rare, and when it does occur, a paralysis of all the muscles which are supplied by it takes place (see muscle table).

Several cords may be injured or affected at one time, but, in the vast majority of instances, a partial lesion of but one cord exists.

For analytic symptomatology, see appended chart, "Brachial Plexus Paralysis."

SUPRASCAPULAR NERVE PARALYSIS

This is in itself of little importance, excepting that there is present a paralysis of the supra- and infra-spinous muscles; there follows a wasting of these muscles and an increase in the impairment of humeral outward rotation and sagging downward of the humeral head. This condition is generally associated with circumflex nerve paralysis.

CIRCUMFLEX NERVE PARALYSIS

Etiology.—(1) Dislocations of shoulder, (2) fractures of the head and neck of humerus, (3) severe falls or strains on the shoulder without fracture or dislocation, (4) wounds of the shoulder joint or girdle, (5) neuritis (apart from injury), (6) tumors.

Symptoms.—*Motor.*—Paralysis of the deltoid muscle, which prevents the patient from raising the arm from the side (may have a slight degree of abduction, due to the action of the supraspinatus muscle); there is a gradual wasting of the deltoid muscle, causing the shoulder to look flattened; and due to the falling downward of the humeral head, a definite hollow may develop between the acromial process and the head of the humerus.

Sensory.—Varied degrees of anesthesia (cutaneous) may be present over the shoulder-girdle.

POSTERIOR THORACIC NERVE PARALYSIS

Etiology.—(1) Blows on the neck and shoulder, (2) severe muscular strain, either immediate or gradual, (3) by direct pressure from the carrying of heavy loads on the neck or shoulder, (4) neuritis (apart from injury), (5) from fractures of the scapula, (6) tumors.

Symptoms.—Paralysis of the serratus magnus muscle, which prevents the patient from raising the arm above the shoulder; the wasting of the serratus magnus muscle is evidenced by a distinct and, at times, deep groove appearing between the posterior border of the scapula and the thorax, when the individual brings the arm forward, the lower angle of the scapula being rotated inwards and upwards giving the appearance of a "winged scapula."

MUSCULOCUTANEOUS NERVE PARALYSIS

Etiology.—(1) Direct injury to nerve, (2) dislocation or fracture, (3) post fracture callus, (4) wounds of the upper arm with subsequent scar tissue formation, (5) neuritis (apart from injury), (6) tumors.

Symptoms.—*Complete Paralysis.*—In axilla (before giving branches to muscles).

Motor.—There is a paralysis of the coracobrachialis, biceps and brachialis anticus muscles with a weakness of hand supination and forearm flexion. A wasting of the above muscles is noteworthy. If the arm is in midposition between pronation and supination, flexion may be accomplished through the action of the supinator longus muscle.

Sensory.—Along the antero-external and postero-external aspects of the forearm there will be scattered areas of anesthesia.

MUSCLES INVOLVED IN MUSCULOCUTANEOUS NERVE PARALYSIS

Muscle	Function	Impaired Function
Coracobrachialis	Draws arm forward and inward Assists in elevating arm toward scapula	Partial loss of elevation of arm forward and inward
Biceps	Flexor of forearm; aids in supination	Partial loss of forearm flexion and supination
Brachialis anticus	Flexes forearm on arm Flexes arm on fixed forearm	Partial loss of forearm flexion

MUSCULOSPIRAL NERVE PARALYSIS

Etiology.—(1) Direct injury to nerve, (2) shoulder dislocation or fracture, (3) fracture of humeral shaft, (4) post fracture callus, (5) wounds of arm, with subsequent scar tissue formation, (6) neuritis (apart from injury), (7) tumors, (8) pressure (crutch or position).

Symptoms.—SYMPTOMS DEPEND UPON LEVEL OF LESION.

A. *High Lesion in Axilla* (before it gives off its branches to the triceps and anconeus muscles).—**Motor.**—There is a complete paralysis of the triceps, anconeus, brachioradialis, brachialis anticus, extensor carpi radialis longior, extensor carpi radialis brevior, extensor communis digitorum, extensor minimi digiti, extensor carpi ulnaris, supinator brevis, extensor indicis, extensor brevis pollicis, extensor longus pollicis, and extensor metacarpi pollicis muscles.

Sensory.—“There is loss of sensation over an area on the dorsal surface of the hand extending from between the dorsal aspect of the thumb and the base of the index finger, upwards toward the middle of the wrist. Loss of sensation on the dorsal surface of the elbow and back of the upper arm may also be detected by careful examination in some cases” (Sir Robert Jones).

Diagnosis.—Loss of extension of forearm. Impairment of elbow flexion, and though the elbow may be flexed, it is noted that during this movement, the strong contraction of the brachioradialis on the unimpaired side will be in a state of definite contraction while the brachioradialis on the affected side will remain without contraction. Loss of voluntary extension of the wrist with an impairment of abduction of the hand. Loss of voluntary extension of the fingers and thumb. Loss of forearm supination when forearm is extended. Ability of the patient to maintain the fingers extended at the interphalangeal joints (due to function of interossei and lumbricales which are supplied by the ulnar nerve). When patient makes an effort to flex the fingers, the wrist becomes partly extended. Loss of triceps tendon reflex. Loss of supinator reflex. Wrist-drop. As a result of the impairment of muscular

MUSCLES INVOLVED IN MUSCULOSPIRAL NERVE PARALYSIS

Muscle	Function	Impaired Function
Triceps	Extends forearm	Loss of extension of forearm on arm
Anconeus	Assists triceps	Impairment of extension of forearm
Brachioradialis	Flexes elbow; may assist both pronation and supination	Impairment of elbow flexion Slight impairment of pronation and supination
Extensor carpi radialis longior	Extends wrist and abducts hand	Loss of extension of wrist Impairment of abduction of hand
Brachialis anticus	Flexes forearm on arm Flexes arm on fixed forearm	Chief nerve supply from musculocutaneous
Extensor carpi radialis brevis	Extends wrist; slightly abducts hand	Impairment of wrist extension and hand abduction
Extensor communis digitorum	Extends phalanges Extends wrist and elbow	Paralysis of extensors of phalanges, especially 2nd and 3rd fingers
Extensor minimi digiti	Extends little finger Extends wrist (slightly)	Impairment of extension of little finger, 2nd and 3rd phalanges
Extensor carpi ulnaris	Extends hand; adducts (ulnar) hand	Impairment wrist extension Impairment ulnar deviation
Supinator (brevis)	Supinates	Loss of supination
Extensor indicis	Extends index finger Extends wrist (slightly)	Impaired extension of index finger
Extensor brevis pollicis	Extends prox. phalanx of thumb	Impaired extension of first phalanx of thumb
Extensor longus pollicis	Extends 2nd phalanx of thumb. Extends and abducts wrist	Impaired extension of 2nd phalanx of thumb
Extensor ossis metacarpi pollicis	Extends and abducts thumb Extends and abducts wrist	Impaired extension and abduction of hand and thumb

Posterior interosseous nerve (terminal branch of musculospiral nerve)

function the position of the forearm and hand becomes quite characteristic and is as follows: The forearm is constantly pronated and if forcibly supinated, springs back to its former pronated position. the wrist is dropped and the fingers are constantly semiflexed at the interphalangeal joints and when the fingers are forcibly extended the wrist becomes flexed. The patient cannot extend the hand upon the forearm and cannot extend the fingers and thumb. If the forearm is flexed upon the arm, the patient cannot extend the forearm. In complete lesions, muscular wasting becomes very marked and there may or may not be nerve and muscle tenderness. Adhesions and contractures of the muscles and tendons may become so pronounced as to cause an almost complete loss of use of hand.

B. Lower Portion of Upper Third of Humerus (slightly lower level than points of origin of branches which supply inner and long heads of the triceps).—Symptoms

as found above this level with the exception that the supinator longus reflex is abolished while the triceps tendon reflex is present.

C. *About the Midportion of the Humerus* (above the origin of the branch to the brachioradialis—supinator longus).—The supinator longus and all the extensor muscles of the wrist, fingers and thumb are paralyzed. The triceps tendon reflex is present. There will be an absence of the strong contraction of the supinator longus muscle as noted in the normal arm when the elbow is brought up into a state of flexion. The extensor action of the wrist, fingers and thumb is absent. Numbness is present over the back of the thumb and about the dorsal aspect of the first interosseous space. Triceps reflex is present. Supinator reflex is absent. Ability to extend forearm is present.

D. *Lower Third of the Humerus* (below the origin of the branches to the brachioradialis and extensor carpi radialis longior).—Extensor carpi radialis brevis and the extensors of the thumb are paralyzed. Supinator longus can well contract. Triceps and supinator longus tendon reflexes are obtained. Anesthesia is present over the dorsum of the thumb and first interosseous space.

E. *About Upper Half of Forearm* (below the branches supplying the radial extensors).—Paralysis of the extensor carpi ulnaris and extensors of the fingers. Wrist can be extended and will be directed to the radial side. Paralysis of one or more than one finger may be noted (often all) due to the separate origin of the nerves to the extensor communis digitorum.

F. *About Lower Half of Forearm*.—Usually only paralysis of the extensor muscles of the thumb and index finger.

It should be noted that about 5 centimeters below the elbow joint, the main trunk has divided into the posterior interosseous and radial nerves, either of which may be injured. The interosseous is entirely motor, the radial is purely sensory. We may therefore note either motor or sensory disturbances or both.

In the middle of the forearm radial nerve implication will be total, the anesthesia being identical at this and higher levels, as the nerve does not divide into its distributing filaments until it reaches the wrist.

MEDIAN NERVE PARALYSIS

Etiology.—(1) Direct injury to nerve, (2) dislocation or fracture, (3) post fracture callus, (4) wounds of arm with subsequent scar tissue formation, (5) neuritis (apart from injury), (6) tumors.

Symptoms.—SYMPTOMS DEPEND UPON LEVEL OF LESION.

A. *Complete Paralysis* (lesion in upper arm, at or above the elbow).—Motor.—(1) Inability to pronate forearm beyond midposition between pronation and supination. (2) An impairment of wrist flexion without contraction of flexor carpi radialis, palmaris longus or flexor sublimis digitorum muscles. (3) Loss of flexion (or if present, very slight) of the proximal and distal phalanges of the thumb and very often loss of extension of distal phalanx of the thumb. Loss of power of abduction and of opposing thumb. (4) Loss of flexion of the index finger at the interphalangeal joints and the presence of flexion of the index finger at the metacarpophalangeal joint. (5) Almost, but not complete, loss of flexion of distal phalanx of the middle finger. (6) Presence of flexion of all fingers at the metacarpoph-

MUSCLES INVOLVED IN MEDIAN NERVE PARALYSIS

Muscle	Function	Impaired Function
Flexor carpi radialis	Flexes hand, pronates forearm	Partial loss of wrist flexion and partial loss of pronation
Flexor sublimis digitorum . . .	Flexes 2nd phalanx, 2-3-4-5 fingers	Loss of flexion of 2nd phalanx of 2-3-4-5 fingers
Flexor profundus digitorum (radial $\frac{1}{2}$)	Flexes 2-3 phalanges of 2-3 fingers	Loss of flexion of 2-3 phalanges of 2-3 fingers
Flexor longus pollicis	Flexes 2nd phalanx of thumb	Loss of flexion of 2nd phalanx of thumb
Flexor brevis pollicis	Flexes 1st and extends 2nd phalanx of thumb Aids opposition	Loss of flexion of 1st and loss of extension of 2nd phalanx of thumb
Palmaris longus	Flexes hand, makes aponeurosis palmaris tense	Partial loss of wrist flexion
Pronator radii teres	Pronates and aids in flexion of forearm	Partial loss of pronation and partial loss of flexion of forearm
Pronator quadratus	Pronates forearm	Partial loss of pronation of forearm
Abductor pollicis brevis . . .	Abducts thumb	Loss of abduction of thumb
Opponens pollicis	Opposes thumb to other fingers	Thumb cannot be brought to finger tips
Lumbricales (radial 2)	Flexes basal phalanges of 1-2 fingers and extends 2-3 phalanges of 1-2 fingers	Loss of flexion of basal phalanges of 1-2 fingers and loss of extension of 2-3 phalanges of 1-2 fingers

phalangeal joints and of extension of fingers at phalangophalangeal joints (thumb, at times, being excepted).

Sensory.—Anesthesia is present over a fairly wide distribution, including the palmar surface of the thumb, index and middle fingers and the radial half of the ring finger and in the corresponding part of the palm up to the fold of the wrist. On the dorsal surface, the anesthesia extends over the back of the terminal phalanx of the thumb and of the second and third phalanges and half of the first phalanges of the index and middle fingers and corresponding radial area on the ring finger. (Sir Robert Jones, *Orthopedic Surgery of Injuries*, London, Frowde, 1921, p. 97.) It must be remembered that total anesthesia of the above described area is rare and we more usually find a blunting of sensation to pin pricks and the like. Hyperalgesia on deep pressure over this blunted area is often pronounced. Joint sense is lost in thumb, index and middle fingers. Pain is a variable sign; it may be severe or it may be almost entirely absent.

Vasomotor and trophic disturbances are, as a rule, more pronounced in lesions of the median nerve than in those of the ulnar nerve. This is especially so in the *irritative* and *incomplete* lesions and in those accompanied by vascular lesions. The cutaneous surfaces of the hand and the nails of the corresponding region often show marked changes, in that the nails are often frayed and fissured with hypertrophied

skin at the tips of the fingers, which are markedly sensitive to the touch. There may be excessive sweating over the area involved together with a dry desquamation of the skin. A noteworthy sign, so often found, is that the two terminal phalanges of the index and middle fingers may be blue and cold.

The hand often shows a slight degree of adduction with a wasting of the thenar eminence and a flattening of the outer border of the ball of the thumb. The thumb is held extended and adducted to the hand, and falls back to the plane of the other digits forming a so-called "monkey hand."

B. Lesion in Forearm (about 6 cm. below elbow, *i.e.*, below the point at which the branches to forearm muscles originate).—The only muscles showing evidence of paralysis are the abductor and opponens pollicis and the two external lumbricales. In these instances there is a flattening out of the thenar eminence, the thumb falling back to the plane of the other digits forming the "monkey hand." There is usually present a flushed and cyanotic condition of the index finger which extends over the palm and fingers involved in this lesion (thumb, index and middle). Sweat secretion may be excessive and the nails will show nutritional disturbances. Pain is often pronounced. It should be noted that, as the length of the paralysis increases, so will changes in contour of the hand become more evident, until finally the nails of the thumb, index and middle fingers become large, crinkled and striated; these fingers begin to become more constricted and taut until they assume the clawlike type.

ULNAR NERVE PARALYSIS

Etiology.—Penetrating wounds in every part of its course. In civil life the nerve is most commonly injured in penetrating wounds about the wrist joint; also by direct blow or accompanying fractures and dislocations at elbow, as the nerve passes behind the internal condyle. There may be a gradual development as result of prolonged irritation of a nerve sheath and final compression of the nerve, as associated with an old elbow injury, or in special movements of individuals in which relation between nerve to condyle is abnormal. Post fracture callus; wounds of arm with subsequent scar tissue formation; neuritis (apart from injury); tumors.

Symptoms.—SYMPTOMS DEPEND UPON LEVEL OF LESION.

A. Lesion in Upper Arm at, or above, Elbow.—Motor.—This brings on a complete paralysis and is shown by the following: Loss of volar and ulnar flexion of the wrist; loss of flexion of the terminal phalanges of third and fourth fingers; inability to bring taut the skin on ulnar border of hand.

Loss of flexion of first phalanx of thumb. Inability to approximate thumb to index finger. Loss of power of abduction of little finger. Loss of flexion of first phalanx of little finger. Little finger becomes unopposed. Loss of flexion of basal phalanges of third and fourth fingers. Loss of extension of second and third phalanges of third and fourth fingers. Loss of power of abduction and adduction of fingers.

Sensory—Total.—Loss of cutaneous sensation in little finger and ulnar half of ring finger and corresponding part of hand, front and back, not extending above wrist. Loss of sensation to deep pressure limited to little finger. Loss of joint sense in little finger and sometimes in ring finger.

B. In Middle Third of Forearm (after it has given off its dorsal cutaneous branch).—Loss of sensation in palmar surface of hand and fingers extending to dorsal surface of the two terminal phalanges of ring finger on its ulnar side.

C. In Hand (after nerve has given off its last cutaneous branch).—No area of anesthesia.

Pain.—At moment of injury shooting down arm to two ulnar fingers, but not very severe or lasting (as a rule, as compared with median).

Diagnosis.—As the result of the above muscle and tendon impairment, the following clinical signs develop. The hand is usually slightly abducted and the little finger remains in a position of hyperextension at the metacarpophalangeal joint, and is slightly abducted; there is usually a certain amount of flexion at the phalango-phalangeal joints. The ring finger assumes the same attitude as does the little finger, but not to as marked a degree. Atrophy of the hypothenar eminence, adductors of the thumb and of the interossei and the lumbricales causes the metacarpal bones to become markedly prominent and gives to the hand a skeleton-like appearance. The inner side of the forearm becomes wasted and the long flexor tendons become visible as longitudinal ridges in the palm. There is an inability to spread out the fingers in fanlike fashion. Also inability to fully extend the middle and distal phalanges and inability to flex the terminal phalanx of the little or ring fingers. The general appearance that the hand assumes is known as “ulnar griffe,” “claw-hand” or “main en griffe.” Though flexion of the wrist is possible, though not frequent, no contraction of the flexor carpi ulnaris will be felt and the hand becomes slightly abducted. Simultaneous flexion of the fingers at the metacarpophalangeal joints and extension at the interphalangeal joints is impossible.

Steward and Evans (*Nerve Injuries*, London, Frowde, 1919, pp. 164-165) quote Froment (*Presse Médicale*, Oct. 21, 1915) and give the following picture, which is one of the most constant signs of ulnar palsy, and is as follows: “It is demonstrated by handing the patient some thin object, such as a sheet of paper, and asking him to catch firm hold of it, first with the normal hand and then with the paralyzed hand. Or we may get the patient to hold the paper in both hands and to pull them in opposite directions. On the normal side the whole length of the thumb is held in contact with the paper, pressing it against the index finger, the terminal phalanx of the thumb being extended or, perhaps, slightly flexed. On the paralyzed side, however, prehension is weakened and only the pulp of the thumb tip touches the paper; the terminal phalanx of the thumb becomes flexed and the paper is held between the tips of the flexed thumb and flexed index finger. Other than at their tips, the thumb and index finger are separated by an open space. This prehension, ‘à bout des doigts,’ is carried out by the long flexors of the thumb and index finger, assisted by the opponens pollicis, all of which are innervated by the median nerve.”

The vasomotor and trophic disturbances are less marked than in median nerve paralysis, though the ulnar area may be cold and somewhat cyanotic, especially in the cold weather or in long standing cases. Nutritional disturbances in the nails of the little and ring finger are occasionally noted, especially in irritation lesions of the nerve—when redness and sweating may be accompanying signs. An epidermal thickening over the palmar distribution of the ulnar nerve occurs in old standing cases. Sores and ulcerations due to burns, etc., may develop in the anesthetic area.

D. *Lesion in Forearm below Elbow* (below origin of flexor carpi ulnaris and inner half of the flexor profundus digitorum).—Motor.—The paralysis is confined to the ulnar hand muscles, though the appearance of the hand may assume the same picture, clinically, as in a complete lesion with the exception that there is present volar and ulnar flexion at the wrist, presence of flexion of the terminal phalanges of third and fourth fingers and there will be present the ability to contract the flexor carpi ulnaris muscle.

Sensory.—There is a loss of sensation in the palmar surface of hand and finger extending to the dorsal surface of the two terminal phalanges of the ring finger on its ulnar side, when the injury occurs in the middle third of the forearm after it has given off its dorsal cutaneous branch. If, on the other hand, the injury has occurred in the hand after it has given off the last cutaneous branch, there is no area of anesthesia. At the moment of injury there is generally fairly severe pain shooting down the arm to the two ulnar fingers, but this is not as intense or as lasting as is the case when the median nerve is affected.

MUSCLES INVOLVED IN ULNAR NERVE PARALYSIS

Muscle	Function	Impaired Function
Flexor carpi ulnaris	Volar flexion (when acting with flexor carpi radialis) Ulnar flexion (when acting with extensor carpi ulnaris)	Loss of volar and ulnar flexion (if lesion is at or above elbow)
Flexor profundus digitorum (inner $\frac{1}{2}$)	Flexes terminal phalanges of 3rd and 4th fingers	Loss of flexion of terminal phalanges of 3rd and 4th fingers. (If lesion is at or above elbow)
Palmaris brevis	Tensor of skin of ulnar border of hand	Inability to bring taut the skin on ulnar border of hand
Flexor pollicis brevis (ulnar head)	Flexes 1st phalanx of thumb, aids adduction	Loss of flexion of first phalanx of thumb
Adductor pollicis	Adducts thumb, (approximates thumb and index fingers)	Thumb cannot be approximated to index finger
Abductor digiti quinti	Abducts little finger. (Separates little from ring finger)	Little finger loses power of abduction
Flexor digiti quinti brevis ..	Flexes first phalanx of little finger	Loss of flexion of first phalanx of little finger
Opponens digiti quinti	Opposes little finger	Little finger becomes unopposed
Lumbricales, 3rd—4th	Flexes basal phalanges of 3rd and 4th fingers. Extends 2nd and 3rd phalanges of 3rd and 4th fingers	Loss of flexion of basal phalanges of 3rd and 4th fingers. Loss of extension of 2nd and 3rd phalanges of 3rd and 4th fingers
Interossei	Abducts or adducts fingers and assists lumbricales	Fingers cannot be abducted or adducted

NERVE SUPPLY, MUSCLES OF THE LOWER LIMB (ANTERIOR)

2 Lumbar	3 Lumbar	4 Lumbar	5 Lumbar	1 Sacral	Nerve
		Tensor fascia femoris	Tensor fascia femoris	Tensor fascia femoris	Superior gluteal
Iliacus	Iliacus	Iliacus			Anterior crural
Psoas	Psoas	Psoas			Lumbar plexus
Pectineus	Pectineus				Anterior crural
	Obturator externus	Obturator externus			Obturator
Adductor longus	Adductor longus				Obturator
Adductor brevis	Adductor brevis	Adductor brevis			Obturator
Gracilis	Gracilis	Gracilis			Obturator
Adductor magnus	Adductor magnus	Adductor magnus	Adductor magnus		Obturator-sciatic
Sartorius	Sartorius				Anterior crural
	Quadriceps extensor	Quadriceps extensor			Anterior crural
		Tibialis anticus	Tibialis anticus	Tibialis anticus	Anterior tibial
		Extensor longus digi- torum	Extensor longus digi- torum	Extensor longus digi- torum	Anterior tibial
		Extensor proprius hal- lucis	Extensor proprius hal- lucis	Extensor proprius hal- lucis	Anterior tibial
		Peroneus tertius	Peroneus tertius	Peroneus tertius	Anterior tibial
		Peroneus longus	Peroneus longus	Peroneus longus	Musculocutaneous
		Peroneus brevis	Peroneus brevis	Peroneus brevis	Musculocutaneous
		Extensor brevis digi- torum	Extensor brevis digi- torum	Extensor brevis digi- torum	Anterior tibial

NERVE SUPPLY, MUSCLES OF THE LOWER LIMB (POSTERIOR)

2 Lumbar	3 Lumbar	4 Lumbar	5 Lumbar	1 Sacral	2 Sacral	Nerve
			Gluteus maximus	Gluteus maximus	Gluteus maximus	Inferior gluteal
		Gluteus medius	Gluteus medius	Gluteus medius		Superior gluteal
		Gluteus minimus	Gluteus minimus	Gluteus minimus		Superior gluteal
				Pyriformis	Pyriformis	Sacral branch
				Obturator internus	Obturator internus	Sacral plexus
		Quadratus femoris	Quadratus femoris	Quadratus femoris		Sacral plexus
Adductor magnus	Adductor magnus	Adductor magnus	Adductor magnus			Obturator-sciatic
			Semitendinosus	Semitendinosus	Semitendinosus	Obturator-sciatic
		Semimembranosus	Semimembranosus	Semimembranosus		Obturator-sciatic
				Biceps, long head	Biceps, long head	Obturator-sciatic
			Biceps, short head	Biceps, short head	Biceps, short head	Peroneal
	Popliteus	Popliteus	Popliteus	Popliteus		Tibial
	Plantaris	Plantaris	Plantaris	Plantaris		Tibial
				Gastrocnemius	Gastrocnemius	Tibial
			Soleus	Soleus	Soleus	Tibial & posterior tibial
			Flex. longus digit.	Flex. brevis digit.		Tibial
			Tibialis posticus	Tibialis posticus		Tibial
			Flexor longus hallucis	Flexor longus hallucis	Flexor longus hallucis	Tibial
	Flex. brevis digit.	Flex. brevis digit.	Flex. brevis digit.	Flex. brevis digit.		Internal plantar
	Adductor hallucis	Adductor hallucis	Adductor hallucis	Adductor hallucis		Internal plantar
	Flexor brevis hallucis	Flexor brevis hallucis	Flexor brevis hallucis	Flexor brevis hallucis		Internal plantar
	1st lumbricales	1st lumbricales	1st lumbricales	1st lumbricales		Internal plantar
				Intrinsic foot muscles	Intrinsic foot muscles	External plantar

CAUDA EQUINA PARALYSIS

Etiology.—Gunshot wounds, crushing injuries, fracture of spinal column, tumors.

Symptoms.—SYMPTOMS DEPEND UPON LEVEL OF LESION.

A. *Whole Cauda Equina Affected* (complete paralysis).—Motor.—Paralysis of all the muscles of the lower limbs, which include psoas, iliacus, quadriceps extensor, pectineus, adductors and tibialis anticus, extensors of toes and peronei, muscles of sole and calf of leg, hamstring and glutei, levator ani and perineal muscles.

Sensory.—Total anesthesia, extending up to groin in front, and to upper part of buttocks behind; there is, also, anesthesia of the genitals and loss of control of bladder and rectum.

Reflexes.—Entirely gone (lower limbs).

B. *Lesion below Third Lumbar Root.*—Motor.—Paralysis of all of the muscles of the lower limbs, excluding the quadriceps extensor.

Sensory.—Anesthesia of the anterior, inner and outer surfaces of the knees and leg; the outer surface of leg and dorsum of foot; the sole of foot and calf; popliteal surface—back of thigh and lower edge of buttocks, perineum and skin over tip of coccyx.

Reflexes.—Knee-jerks are preserved, ankle-jerks are lost. Loss of control of bladder and rectum.

C. *Lesion below Second Sacral Root.*—Motor.—No paralysis of lower limbs.

Sensory.—A “saddle-shaped” area of anesthesia on buttocks, perineum, scrotum and penis.

Reflexes.—Loss of control of bladder and rectum.

D. *Lesion below Third Sacral Root.*—Motor.—Control of anal sphincter; paralysis of levator ani.

Sensory.—Anesthesia of anus and its surrounding areas, including skin over tip of coccyx.

SENSORY NERVE SUPPLY OF THE CAUDA EQUINA

<i>Nerve Root</i>	<i>Areas</i>
Anterior Aspect (inner and outer surfaces)	
1. Lumbar	Neighborhood of Poupart's ligament and the iliac crest
2. Lumbar	Upper portion of thigh and buttocks
3. Lumbar	Lower portion of thigh
4. Lumbar	Knee and inner surface of leg
5. Lumbar	Outer surface of leg and dorsum of foot
Posterior Aspect	
1. Sacral	Sole of foot and calf
2. Sacral	Popliteal portion of leg, back of thigh and lower edge of buttocks
3. Sacral	Perineum
4. Sacral	
5. Sacral	
Coccygeal	Skin over tip of coccyx

GREAT SCIATIC NERVE PARALYSIS

Tibial or internal popliteal	{ posterior tibial	{ internal plantar
		{ external plantar
	{ calcaneus	
Peroneal or external popliteal	{ anterior tibial recurrent	
	{ anterior tibial	
	{ musculocutaneous	
Nerve to hamstring muscles		

The nerve is essentially composed of the tibial or internal popliteal, the peroneal or external popliteal and the nerve to the hamstring muscles. In discussing, therefore, a complete paralysis of this nerve, we consider that all the nerves have been severed before giving off any of their branches.

Symptoms.—*Lesion High Up in the Thigh.*—Motor.—If there is an absolute severing of the nerve there will be a partial paralysis of the muscles of the back of the thigh and a complete paralysis of all of the muscles below the knee.

A foot and toe drop develop and voluntary movements of the foot, ankle and toes are impossible. Though the patient is able to walk, the gait is almost pathognomonic of the lesion. The thigh becomes somewhat flexed and slightly abducted and the knee is raised high, in order to clear the ground with the dropped foot. The foot is more or less helpless and is beyond control, owing to the paralysis of the muscles and the anesthesia of the sole. An atrophy of the muscles in the back of the thigh and in the leg ensues.

Sensory.—Anesthesia is present over the outer side of the leg, usually to just below the head of the fibula, over the dorsum and outer side of the foot and over the heel and Achilles tendon.

Loss of sensation of position is present in both toes and foot.

Sensation to deep pressure is absent, if the pressure is exerted over the outside of the foot.

Sensation to vibrations is lost when a tuning fork is placed over the external malleolus.

Pain very often resembles the pain of median nerve paralysis, being spontaneous, sharp and scattered in different areas on the sole of the foot.

Trophic disturbances of the foot often become marked.

Reflexes.—Knee kick is present and the plantar and ankle reflexes are absent.

Tibial or Internal Popliteal Nerve Paralysis

Symptoms.—SYMPTOMS DEPEND UPON LEVEL OF LESION.

A. *In the Thigh or Upper Leg* (complete paralysis).—Motor.—Paralysis of all of the calf muscles and of all of the muscles of the sole of the foot is present, with the result that plantar flexion of the foot and flexion of the toes are impossible; when an attempt is made to adduct the foot, it is drawn upwards (due to the action of the tibialis anticus); there ensues a flattening of the arch, and in walking the patient bears weight on the sole of the foot without being able to rise on the toes. There is an ability to stand on the heel but not on tiptoe.

Sensory.—Anesthesia is present over the sole of the foot (except along its inner border). The outer border of the foot, the under surface of the foot, the under surface of the toes, the anterior surface of the terminal phalanges of the toes and the areas about the Achilles tendon and the heel are all anesthetic.

For other sensory signs see "Great Sciatic Nerve."

Reflexes.—Plantar and ankle reflexes are absent.

B. *Below the Middle of the Leg* (below the nerves to the calf muscles).—Motor.—The nerve as it courses down the back of the leg is known as the posterior

MUSCLES INVOLVED IN TIBIAL NERVE PARALYSIS

Muscle	Function	Impaired Function
Biceps femoris	Extends thigh on pelvis Flexes knee and rotates leg	Impairment of extension of thigh and flexion and rotation of leg
Gastrocnemius	Extends foot (plantar flexion) acting from below, flexes femur on leg	Loss of plantar flexion of foot
Plantaris	Aids gastrocnemius	Function slight compared with gastrocnemius and soleus
Soleus	Extends foot. With gastrocnemius raises body from ground	Loss of plantar flexion of foot
Flexor longus hallucis	Flexes great toe (plantar flexion): aids extension of foot	Loss of plantar flexion of great toe
Tibialis posticus	Extends foot. Inverts foot	Impaired extension of foot Loss of inversion
Flexor longus digitorum ...	Flexes lesser toes (plantar flexion). Aids extension of foot.	Loss of plantar flexion of lesser toes
Flexor brevis digitorum ...	Flexes second phalanges of toes	Loss of flexion of 2nd phalanges, lesser toes
Abductor hallucis	Abducts great toe and flexes proximal phalanx	Impaired abduction and flexion of great toe
Flexor brevis hallucis	Flexes great toe	Impaired flexion of great toe
First lumbricales	See below	See below
Abductor minimi digiti	Abducts little toe and flexes proximal phalanx	Impaired abduction and flexion of little toe
Flexor brevis minimi digiti ..	Flexes little toe and draws its metatarsal bone downward and inward	Impaired flexion of little toe
Interossei	Dorsals: Abduct toes from axis through second toe Plantars: Adduct 3rd, 4th and 5th toes toward the second	Impaired abduction of toes Impaired adduction of toes
2-3-4 lumbricales	Assist flexion of proximal phalanges. Aid in straightening the two terminal phalanges	Impaired flexion of proximal phalanges and impaired straightening of terminal phalanges

tibial nerve and when severed in the above region causes a paralysis of the flexor brevis digitorum, adductor hallucis, flexor brevis hallucis, the lumbricales, adductor minimi digiti, flexor brevis minimi digiti, flexor longus digitorum, and flexor longus hallucis, and interossei, with the result that there is a definite defect in the movements of the muscles of the sole of the foot. Loss of abduction and adduction of the toes, loss of flexion of the toes, hyperextension of the phalanges at the proximal, and hyperflexion of the phalanges at the distal joints are pronounced. The foot becomes thin and the ball of the foot prominent.

Sensory.—Anesthesia is usually confined to the sole of the foot. Pain may be an important factor.

Peroneal or External Popliteal Nerve Paralysis

The peroneal nerve is an integral part of the great sciatic nerve and divides itself into three branches just below the head of the fibula. These branches are: (1) Anterior tibial recurrent, (2) anterior tibial and (3) musculocutaneous.

The nerve is both motor and sensory.

Etiology.—(1) Fractures of femur and fractures of upper end of fibula; (2) lacerations, from sharp instruments; (3) gunshot wounds; (4) following a resection of the fibula; (5) tumors; (6) neuritis (apart from injury).

Symptoms.—SYMPTOMS DEPEND UPON LEVEL OF LESION.

A. *Complete Paralysis* ("upper third of thigh and before giving branches to the short head of the biceps").—Motor.—There is an atrophy of the biceps, tibialis anticus, extensor longus hallucis, extensor longus digitorum, peroneus longus, peroneus brevis, peroneus tertius, and external brevis digitorum muscles, with the result that there is a diminution in the size of the leg on the outer and anterior surfaces. The foot is dropped, the Achilles tendon becomes shortened, the foot becomes inverted, the heel is drawn up and the toes point directly outward. There is an inability to dorsally flex or evert the ankle, adduction of the foot is present and owing to the intact interossei muscles, extension of the distal phalanges of the toes is possible. A definite "steppage" gait is assumed by the patient.

Sensory.—Anesthesia is usually present over the outside of the leg and dorsum of the foot, the leg anesthesia extending, at times, almost to the knee. Joint sense is lost in all the toes and usually at the ankle.

Vasomotor Disturbances.—There is generally some cyanosis of the foot which in turn is slightly swollen. The skin on the sole of the foot becomes thickened and the foot is usually somewhat warmer than the uninjured one.

B. *Lesion below the Head of the Fibula.*—Either the anterior tibial or musculocutaneous nerves (branches of peroneal) may not be involved, in which case the fibers of the tibialis anticus remain intact and there is no anesthesia about the knee; the function of the tibialis anticus, extensor longus hallucis, extensor longus digitorum, peroneus tertius and extensor brevis digitorum remains normal.

In some cases anesthesia is found only in the lower part of the outer surface of the leg and over the dorsum of the foot on its superior and outer surfaces.

D. *Lesions below the Terminal Branches.*—There may be little or no paralysis, and the sensory loss may be confined to the inner or outer portions of the dorsum of the foot.

PERIPHERAL NERVE INJURIES

MUSCLES INVOLVED IN PERONEAL NERVE PARALYSIS

Muscle	Function	Impaired Function
Biceps (short head)	See "Tibial Nerve Paralysis"	See "Tibial Nerve Paralysis"
Tibialis anticus	Dorsal flexor of ankle and aids in inverting foot	Partial loss of dorsal flexion of ankle and of inversion of foot
Extensor longus hallucis. . .	Flexes ankle dorsally and extends great toe	Partial loss of dorsal flexion of ankle and of extension of great toe
Extensor longus digitorum	Flexes ankle dorsally and extends four lateral toes	Partial loss of dorsal flexion of ankle and of extension of the four lateral toes
Peroneus tertius	Flexes ankle dorsally and raises lateral border of foot	Partial loss of dorsal flexion of ankle and of raising lateral border of foot
External brevis digitorum. .	Extends four inner toes	Partial loss of extension of four inner toes
Peroneus longus	Extends ankle, everts foot	Partial loss of extension of ankle and of foot eversion
Peroneus brevis	Same as above	Same as above

The nerve to the hamstring muscles is purely motor. For symptomatology see appended chart, "Muscles Involved in Paralysis of the Hamstring Muscles."

MUSCLES INVOLVED IN PARALYSIS OF THE HAMSTRING MUSCLES

Muscle	Function	Impaired Function
Biceps (long head) . .	Extends thigh on hip; flexes knee joint laterally, rotates thigh on hip. Rotates tibia laterally	Partial loss of extension of thigh on hip, of lateral rotation of thigh on hip; partial loss of knee flexion and of lateral rotation of lower leg
Semimembranosus . . .	Flexes knee joint, medially rotates tibia; extends hip	Partial loss of flexion of knee joint, of medial rotation of lower leg and of extension of hip
Semitendinosus	Same as above	Same as above
Adductor magnus . . .	Adducts and extends thigh	Partial loss of adduction and extension of thigh

MUSCLES INVOLVED IN SUPERIOR GLUTEAL NERVE PARALYSIS

Muscle	Function	Impaired Function
Gluteus medius	Abducts thigh when limb is extended. Aids in supporting body on one limb. Aids internal rotation of thigh	Impaired abduction of thigh; also internal rotation. Difficulty in supporting body on one limb
Gluteus minimus	Same as above*	Same as above
Tensor fasciæ femoris. .	Makes fascia of thigh taut. Supports extended knee. Aids abduction and internal rotation of thigh	Femoral fascia relaxed. Impaired abduction and internal rotation of thigh

MUSCLES INVOLVED IN INFERIOR GLUTEAL NERVE PARALYSIS

Muscle	Function	Impaired Function
Gluteus maximus	Extends thigh upon pelvis. Supports body on one limb. Aids adduction and external rotation of thigh. Draws pelvis backward and makes body erect, after stooping	Cannot extend thigh upon pelvis, or raise body on affected side from stooping posture. Difficult or impossible to stand on affected limb alone. Impaired adduction and external rotation of thigh

LESSER SCIATIC NERVE PARALYSIS (SENSORY NERVE)

Function	Disturbance of Function
A sensory nerve, supplying the skin over the lower buttock and posterior surface of thigh; sometimes the skin of popliteal region and upper portion of calf	Anesthesia of lower buttock and posterior surface of thigh. Occasionally, anesthesia of popliteal region and posterior surface of upper leg, as well. Rarely involved alone

ANTERIOR CRURAL NERVE PARALYSIS

Etiology.—(1) Gunshot, incised and lacerated wounds; (2) crushes involving fracture of pelvis or femur; (3) tumors; (4) neuritis (apart from injury).

Symptoms.—A. *Complete Paralysis.*—This is a rare condition, unless the case be rapidly fatal, due to a concomitant damage of the femoral vessels.

Motor.—Partial loss of flexion and adduction of the hip together with a partial loss of flexion of the leg upon the thigh and the thigh upon the pelvis. Owing to weakness of extension of the leg at the knee, and to the inability of the patient to keep the leg extended once it has become slightly flexed, the walking becomes difficult and the giving way of the knee and the falling down of the individual results.

B. Lesion Lower Down in the Leg.—Causes a weakness of extension of the leg at the knee, which is not, however, as pronounced as is noted when there is a complete separation high up.

Sensory disturbances are variable and depend upon the extent and upon the level of the lesion. Impairment of sensation may be noted over the front of the thigh as far as the knee, and along the inner side of the thigh to the level of the middle and lower third. Anesthesia may be noted about the internal malleolus and along the inner side of the foot; the skin over the front of the knee may be involved.

In many cases of a less complete lesion, scattered small areas of the sites above noted may only be involved.

Reflexes.—The knee kick is absent or diminished.

MUSCLES INVOLVED IN ANTERIOR CRURAL NERVE PARALYSIS

Muscle	Function	Impaired Function
Iliacus	Bends lumbar portion of pelvis forward	Partial loss of ability to bend lumbar portion of pelvis forward
Pectineus	Aids in adduction and flexion of hip	Partial loss of flexion and adduction of hip
Sartorius	Flexes leg upon thigh and thigh upon pelvis. Rotates thigh outward	Partial loss of flexion of leg upon thigh and of thigh upon pelvis: partial loss of outward rotation of thigh
Quadriceps extensor	Extends leg upon thigh and assists in flexing thigh on pelvis. Draws patella inward and upward	Partial loss of extension of thigh upon pelvis. Restriction of patellar movements

OBTURATOR NERVE PARALYSIS

Etiology.—Rare owing to the deep situation of this nerve and occurring usually in cases of fatal crushings of the pelvis and lower trunk.

Symptoms.—*Motor.*—An almost complete paralysis of the muscles of adduction, a weakened power of external rotation of the thigh and of flexion of the thigh on the pelvis. Movements to cross one leg over the other are interfered with.

Sensory.—Disturbances are localized to small areas of sensory loss over the distribution of the nerve.

MUSCLES INVOLVED IN OBTURATOR NERVE PARALYSIS

Muscle	Function	Impaired Function
Adductor longus	Adducts and assists in flexing thigh	Partial loss of flexion and adduction of thigh
Adductor brevis (usually) ..	Adducts and flexes thigh	Partial loss of flexion and adduction of thigh
Gracilis	Adducts thigh. Flexes and medially rotates the lower leg	Partial loss of adduction and flexion of thigh and partial loss of medial rotation of lower leg
Pectineus (may receive a branch from this nerve)	Aids in adduction and flexion of hip	Partial loss of flexion and adduction of hip
Obturator externus	Mainly a lateral rotator of thigh. Also flexes and adducts thigh	Partial loss of flexion and adduction of thigh and of partial lateral rotation of thigh
Adductor magnus	See "Tibial Nerve Paralysis"	See "Tibial Nerve Paralysis"
Adductor brevis	Adducts and flexes thigh	Partial loss of adduction and flexion of thigh

CHAPTER XI

BONES AND JOINTS

AFFECTIONS OF BONE

In the consideration of bone lesions, it should be borne in mind that six distinct classes present, namely:

Changes due directly to injury.

Those produced by the various pathogenic organisms, including the ordinary pyogens and those causing actinomycosis, syphilis and tuberculosis.

Those apparently due to some diathesis or vitamin deficiency affecting all or many bones, such as rickets, osteomalacia and acromegaly.

Those caused by disease.

Cysts which may be primary or secondary and in which should be included echinococcus disease.

Tumors.

Injuries {
contusions
wounds
fractures
dislocations

Atrophy

Hypertrophy

Inflammatory conditions {
acute {
periostitis {traumatic
infective
osteomyelitis {hematogenous
subacute
abscess {subperiosteal
intramedullary
chronic {
periostitis
osteomyelitis {infective
hemorrhagic
sclerosing, non-suppurative (Garre)
abscess (intramedullary)

Necrosis or caries {
degenerative {malignant
injury
pressure
infective
phosphorus

Granulomata	{	actinomycosis		
		tuberculosis		
		syphilis	congenital {periostitis osteomyelitis osteosclerosis	
			acquired {periostitis osteitis osteomyelitis gumma	
Osteochondritis	{	deformans juvenilis (Perthes' disease)		
		Osgood-Schlatter's disease		
		Kohler's disease		
		vertebral epiphysitis		
		os calcis epiphysitis		
	{	osteochondritis dissecans (Konig)		
		osteochondritis syphilitica		
Dystrophies	{	chondrodystrophia fœtalis		
		osteodystrophia cystica		
Diseases	{	Barlow's disease (infantile scurvy)		
		rickets		
		acromegaly		
		osteomalacia		
		osteosclerosis fragilis generalisata (Albers-Schönberg disease; osteogenesis imperfecta; fragilitas ossium)		
Aneurysm				
Exostoses				
Osteitis deformans (Paget's disease) classed with "Tumors."				
Cysts	{	osteitis fibrosa cystica (von Recklinghausen)		
		solitary		
Tumors	{	benign	chondroma	
			fibroma	
			osteoma {ivory cancellous	
			myxoma	
			angioma	
			central giant-cell tumors {bone cyst giant-cell tumor	
			myxosarcoma (usually benign)	
		malignant	carcinoma	
			sarcoma {spindle-cell round-cell periosteal giant-cell (see Codman's classification, p. 404)	
			endothelioma (Ewing's tumor)	
Myeloma	{	plasma-cell		
		lymphocytic		
		myelocytic		
		arthroplastic		

History

Age; Occupation

Family History.—Bony deformities, rickets, “fragile bones,” multiple fractures, rheumatism, carcinoma, sarcoma, syphilis, tuberculosis, nervous affections and “blood diseases.”

Personal History.—Any bone or joint affections, when a baby or in later life, such as rickets and its complications: Acute exanthemata, infantile paralysis, spinal meningitis, influenza, typhoid fever, tuberculosis, “bone or joint abscess” or any nervous affection. Dates of each. Injury, including fractures and dislocations. Alcoholic and venereal history. Exposure to elements.

Present Illness.—Onset, time and character, and relation between any disease or injury. Trace course of affection and give dates. Pain: radiation, character and time. Is it related to muscular or joint movements? Is it increased or diminished when standing or bending? Is it increased or diminished at night and is it directly over site of supposed affection or is it referred to other parts? History of paroxysmal attacks of abdominal pain. Night cries. Muscular cramps and location. Headache (time and severity). Night-sweats. Chills and fever and type of temperature (continuous or intermittent).

Physical Examination.—Complete and accurate description of part involved including its relation to the physiology and mechanics of movement; perceptible change in size and contour of bone or joint, presence or absence of true or apparent shortening. Contractures, muscle spasm or tremor; sinus formation, signs of surrounding inflammation, visual signs of swelling or true tumor formation. Pulsation (visual). Measurements. Signs of preëxisting rickets; signs of any nervous disease; eye-ground examination. Temperature. Palpation of affected bone or bones, joint or joints for tenderness and pain, directly over site of supposed lesion and distant from it. Presence of swelling or tumor formation (contour, consistency, pulsation, signs of deep or superficial inflammation, areas of softening or true fluctuation). Determine, if possible, whether thickening, if present, is osseous or periosteal, and thorough manipulative tests for impaired function. Crepitation; bony necrosis (perhaps with probe). Reflexes. Disturbances of sensation. Percussion of bone for signs of tenderness and pain, either directly over site of lesion or referred. Complete examination of thorax for bony deviation or pulmonary or cardiac pathology. Examination of lymph glands, both regional and otherwise. Examination of abdomen, including liver and spleen. Examination of prostate. Examination of blood (differential, leukocytes, Wassermann reaction and, at times, blood culture)—animal inoculation. Radiography, including chest. Bacteriologic examination of discharge. Tuberculin test. Reaction to antisyphilitic treatment. Examination of urine for Bence Jones bodies.

Injuries

Contusions.—These are of common occurrence and are the result of direct violence. See “Acute Traumatic Periostitis.”

Wounds.—These are surgical entities and should not be confused with fractures. Gunshot injuries, lacerations of the bone from sharp instruments, such as

an ax, and the like, may cause a minimum amount of solution of bone continuity. Swelling, tenderness and often subcutaneous ecchymosis with a palpable "bone furrow" are the signs and symptoms of this condition. The degree of minimal bone destruction only, distinguishes the condition from a fracture. See chapter on "Fractures and Dislocations."

Atrophy

Bone atrophy is due to several causes, the most important of which are: (1) Lack of use, *i.e.*, in amputation stumps and about fractures; (2) lesions of the central nervous system; (3) pressure; (4) nutritional disturbances caused by toxic irritants or physiochemic processes brought on by the edema and stasis of venous congestion. DaCosta states that there is a diminution in the amount of bony matter without any change in the osseous structure. Allison and Brooks, who have done a large amount of animal research on the subject, say that the affection is a manifestation of bone-cell production of bone matrix, which is distinct from the function of regeneration.

Radiographic examination may show an acute, subacute or chronic form of bone atrophy. In the acute form the bone appears blurred, cloudy and granular, with a characteristic punched out defect, due to lime absorption and enlargement of the medullary spaces. In the subacute and chronic forms, the trabeculae become more distinct and the bone structure more transparent; the cortex is clear cut and thinned.

After an injury or other causative factor there may be some swelling of the feet and ankles, coldness of the feet, sensations of tingling and numbness in the extremity and, at times, actual pain. In some cases there is an absence of pulsation of the tibialis posticus or dorsalis pedis. There are no definite, pathognomonic symptoms of bone atrophy; in all cases, the affected extremity does not improve but stiffness and pain persist for many months. Noble and Hauser conclude, in a review of the subject, that acute bone atrophy is a definite clinical entity with typical history, clinical picture and characteristic x-ray findings and is explained by reflex trophoneurotic action following injuries.

Hypertrophy

Hypertrophy, though not commonly found, is occasionally noted in the bones of the face and tibial shaft. Though of unknown etiology, there are cases which would suggest an effort on the part of nature to form new bone upon bony tissues which have been subjected to destruction, either pathologic or mechanical. From a surgical angle, deformity or pressure symptoms may present. In certain cases without apparent deformity, radiographs will elucidate the condition.

Inflammatory Conditions

Acute Traumatic Periostitis.—Those bones which are most easily subjected to direct injury are usually involved in this type of affection, and include the external and internal malleolus, the olecranon process, the knuckles, great trochanter, anterior superior spine, and the like. Pain, swelling and tenderness, following

a blow or fall, are the usual symptoms. Enlargements of this character are felt by placing the tips of the fingers extremely lightly over the bone involved and palpating over the entire palpable portion of the bone. In itself, this is not a serious condition and there may shortly ensue, following the injury, a direct absorption of the inflammatory elements; there may occur a degeneration of the inflammatory exudate, evidenced by a soft and at times a semifluctuant swelling which slowly becomes absorbed without giving signs of infection. On the other hand, a definite infection of the inflammatory elements may occur, in which instance a mass presents, usually semifluctuant or fluctuant, in character, surrounded by an indurated zone of inflammation and accompanied by the usual symptoms of localized infection. Definite acute involvement of the marrow often occurs in which we may have all the symptoms of an acute osteomyelitis.

Acute Infective Periostitis.—This condition is a part of an acute osteomyelitis or subperiosteal abscess, and in the present state of our knowledge should not be looked upon as a definite entity. In the milder cases, and these are the most common, localized tenderness of a portion or of the whole bone shaft with a complete absence of visible signs of inflammation is the symptom-complex. There are cases, however, in which the cardinal signs of inflammation, including marked tenderness of the bone on palpation and light percussion, accompanied by high fever, chills and severe constitutional disturbances are present. This condition may assume a most serious aspect and septicemia may finally ensue. In this type of case, bone invasion has occurred.

Acute osteomyelitis is an acute inflammatory condition of the bone-marrow, brought about by pyogenic organisms. It is an affection especially found in children and young adults, though older people, at times, present this condition. It is most frequently found in the male.

When found in an adult, the disease is supposed, under ordinary conditions, to be an awakening into activity of a preëxisting focus. One or several bones may be affected simultaneously; the beginning of the infection is found invariably in the shaft, near the epiphyseal lines; at times, it involves secondarily the adjacent joints. Occasionally, though rarely, it may be primarily in the epiphysis. In order of frequency, we may consider the tibia, femur (especially lower end), humerus, ulna and pelvis (especially crest).

From an etiologic standpoint, the following should be considered:

1. Trauma with or without apparent injury to the overlying skin. It may be severe or slight, establishing a "locus minoris resistentiæ." In military practice, the infection usually comes through the skin (Kidner).

2. An antecedent infectious disease such as one of the acute exanthemata, influenza, tonsillitis, furunculosis, etc. As a matter of fact, the presence of a hidden focus of infection anywhere in the body may bring about a secondary involvement of the bone-marrow. The organisms most commonly found are the *Staphylococcus pyogenes aureus*, streptococcus, typhoid bacillus, pneumococcus, and influenza bacillus. Any pyogen may be the etiologic factor.

3. Exposure and exhaustion, which in themselves are merely factors in reducing the resistance of an individual.

4. Fracture, either simple or compound.

The *acute hematogenous* form is most commonly encountered between the ages of two and ten years, and presents a train of signs and symptoms referable to a general systemic reaction which includes the following: Acute onset, high, usually continuous fever, often accompanied by chills (at times, the fever may be absent for a day, to be followed the next by a high rise). Intense pain or dull ache over the affected parts with more or less diffuseness over its entire neighborhood; extreme tenderness on percussion over the involved area of bone, and to a lesser degree, noted over its entire extent, especially in the epiphyseal line. Increase of pain at night often occurs. There are exceptional cases in which pain is not present. Edema and signs of inflammation show themselves over the affected area and in neighboring parts, but these signs should be looked upon as occurring in the later stages and not included as part of a symptom-complex. Leukocytosis is present. The entire reaction may be a manifestation of a septicemia or pyemia. A positive blood culture may or may not be present.

Subacute osteomyelitis represents a stage of an osteomyelitic condition in which the toxemia has been overcome, though suppuration still exists. There is more or less of a continuance of the symptoms of the acute stage with less intensity, though the physical signs are more pronounced. The fever may be very high (night rises are especially common), though chills are most unusual. Pain may or may not be present, but it is generally of the deep gnawing type so often described as "exaggerated growing pains." Percussion over the affected area may elicit tenderness and, indeed, this sign may be present over the entire limb; the exquisiteness of soreness is not as pronounced as is noted in the acute state and may be, in exceptional cases, entirely absent. Edema and signs of superficial inflammation are more pronounced than are noted in the acute form. There is observed often a definite localized swelling and superficial fluctuation with a limb more or less reddened and edematous. In this stage, encroachment about the joint is occasionally seen, giving to the joint a "puffed-up" appearance, with impairment of joint function. The surface of the bone may show nodules and irregularities. Leukocytosis may or may not be high, but usually exists. Blood culture, under ordinary conditions, is negative. If the lesion is entirely circumscribed, symptoms are less severe and the pains are boring in character and especially pronounced at night. This condition may be prolonged over a period of weeks or months, and is commonly recognized as a so-called *Brodie's abscess*. Multiple lesions are not uncommon.

Chronic periostitis is a condition due to a long-standing periosteal irritation in which the periosteum has become thickened. There may be painless, hard swellings over the site of involvement.

Chronic Osteomyelitis.—In this osteomyelitic stage, bone cavities usually develop, with the formation of a sequestrum or involucrum. Systemic symptoms are entirely absent and a sinus usually presents. The extent of the bone lesion depends upon the virulence of the infection and the resistance of the bone to the infection. Acute exacerbations are common.

Symptoms.—Long persisting sinuses which discharge pus in variable amounts. When the discharge is slight in amount, the sinus may crust over and appear to heal up, only to open again with pain and a discharge of an increased amount of secretion. The condition may persist for years. Acute exacerbations often occur. The disease often starts as the acute type or is chronic from the beginning. Swell-

ing, tenderness and but slight constitutional disturbances may terminate in suppuration or in bone hypertrophy.

Mitchell has divided *osteomyelitis in children* into three types:

1. Localized infection at the end of a long bone with a long history and no severe general infection.
2. Short history of trouble (twenty-four hours or less) with severe general infection with strictly localized exquisite tenderness on pressure at one end of the shaft.
3. Considerable denudation of the periosteum over the whole shaft.

The disease is common.

Sclerosing Non-Suppurative Osteomyelitis (Garre).—The symptoms are those of an enlargement and thickening of the bone, without the presence of suppuration or sinuses. The onset is acute with high fever and swelling. Pain at the site of lesion with surrounding infiltration of the soft tissues is present, though the skin is rarely reddened.

Necrosis or Caries

Necrosis of bone is the death of osseous tissue resembling gangrene. It follows injury, infection, chemical irritants or other toxins and tumors. Tearing off of the periosteum or having it destroyed by an inflammatory condition depletes the blood supply to such an extent that death of the osseous tissues follows. Osteomyelitis is the most common cause of necrosis. In an osteomyelitis, the blood-vessels are occluded by infective thrombi, and a portion of the bone dies, forming a *sequestrum*. When necrosis occurs without suppuration, a bone tumor or prolonged exposure to mercury or phosphorus are, as a rule, the etiologic factors to be considered. The latter often causes necrosis of the jaw by gaining entrance to the bone through decayed teeth of a person exposed to phosphorus fumes.

Granulomata

Actinomycosis of bone is most frequently found in the jaw but other bones may be involved secondarily. The ray-fungus is, as a rule, carried to the mouth by straw, and infects the gums and other tissues about the teeth. The skin may be the site of primary infection. The process readily extends to the bone, where a dense fibrous layer is soon formed, enclosing a collection of pus which contains the characteristic sulphur granules. Usually the first symptoms appear after the jaw bone becomes involved; there then follows swelling and pain and often the formation of a sinus which discharges this destructive pus. At an earlier stage, aspiration will give the same findings.

Tuberculosis of the Bone.—This is one of the most common forms of tuberculosis, and though it may occur at any age, it is most commonly found in childhood and young adult life. The epiphyseal ends of the long bones and the cancellous tissues of the short bones are the most common sites of the disease. At times, however, numerous foci may be found in various locations of the medulla of the long bone, coalescing and forming an extensive tuberculous mass. As the disease progresses, the soft overlying tissues become infected and break down into abscess

formation and, at times, into extensive ulcerations. The infection is usually of hematogenous origin, though it may be secondary to a tuberculosis elsewhere in the body. Neighboring joints become infected promptly and hence it is that joint lesions of tuberculous origin are so often noted. Sex is not a diagnostic factor. The epiphyseal ends of the femur, tibia, humerus, ulna, radius, fibula, and the clavicle, together with those of the carpus and the tarsus, are the most frequently affected. In the fingers, a spindle-shaped enlargement of the affected phalanx often presents, and in the other bones affected, localized swellings are, at times, pronounced. It is safe to say, however, that tuberculosis may involve any portion of the bony framework of the body. Recent investigation has proven that the disease more commonly occurs away from the joints than has heretofore been supposed. The diagnosis of bone tuberculosis is quite simple after there has been a perforation with its abscess formation or ulceration of the overlying soft parts. On the other hand, an early tuberculosis may present numerous difficulties in diagnosis in its incipient stages and the greatest effort should always be made to determine a correct diagnosis in its earliest form. The symptoms vary, depending upon the location of the lesion. If the lesion is situated in the epiphyseal end of the long bone, the predominating symptoms may present as a joint lesion rather than as a primary bone infection. In this type of case, a swelling accompanied by a moderate degree of discomfort upon pressure or movement of the joint may be noted. Premonitory signs of an indefinite pain in the joint or bone may appear before the joint swelling. The pain is never of the acute type and there are no signs or symptoms which would indicate a pyogenic infection, though a slight rise of temperature usually accompanies the lesion. As the disease progresses the swelling increases, the mobility of the joint becomes more impaired and a more or less spindle-shaped mass appears. A semi or a definite fluctuation may or may not present. It should be borne in mind that a very advanced stage of bone tuberculosis may not, at any time, give rise to definite pain. In cases of tuberculosis confined to the bone alone, the first symptom is usually a dull pain with a very insidious onset, and upon inspection and palpation, no abnormalities of the bone may be detected. On percussion, however, the bone will usually show a moderate degree of tenderness. As the lesion progresses a moderate distortion of the bone may present and this is especially noted in the phalanges, in which case a marked spindle-shaping of the finger becomes noted. Fluctuation and ulceration, though not commonly found in this type of case, may show themselves. *Sinus formation* is one of the diagnostic signs of a tuberculous bone lesion. Too much stress cannot be laid upon the importance of the discovery of a tuberculous bone lesion of childhood. The bones of the pelvis, ribs, sternum, skull and spine are not infrequently the site of the disease. For tuberculous lesions of a regional nature see various chapters.

Syphilis may occur in any bone and at any age. The symptoms and clinical findings will depend on the exact condition present. In *congenital* syphilis the bone changes are more uniformly present than in any other lesion. The long bones are chiefly affected, near the epiphyseal cartilage, the condition being termed epiphyseal osteochondritis. There is inhibition of bone formation with such resulting weakness at the epiphyseal line that fracture easily follows some slight injury either in intra-uterine life or after birth. Often the bone changes go unrecognized until discovered at autopsy. Osteoperiostitis is common in hereditary

syphilis, affecting especially the shafts of the long bones of the leg, forearm and hand, and also the cranium with formation of nodes (*Parrot's nodes* or hot-cross bun skull). Another type is found in the parietal bones in the first six months of life with localized absorption of osseous tissue, crackling like parchment when palpated, called *craniotubes*. When the long bones are affected, there is a gradual increase of the deformity; tenderness on pressure over the affected bone and pain in the extremity, worse at night, are not uncommon symptoms. There may be a suppuration of a sluggish nature, the sinuses draining for a long period of time (Holt). Under appropriate treatment, the periosteal thickenings may entirely disappear but the newly formed bone persists.

In the *secondary* stage of syphilis, bone involvement has been encountered rarely; there may be flying pains in the long bones or a periosteal node on the tibia, tender on pressure and the seat of a deep aching pain, usually worse at night. Campbell states that gross pathologic changes in bone are found in the *tertiary* stage. Three-fourths of all cases are due to acquired syphilis, one-fourth to congenital. The chief syphilitic bone change of the tertiary period is gumma formation, either subperiosteal or within the marrow cavity. When on the surface of the bones, usually the sternum, clavicle, ribs and, rarely, the long bones, there appears a reddening and softening of the skin over the affected areas, syphilis should be suspected. After remaining indolent for a long time, the skin may open; or being incised, a yellowish, gelatinous matter escapes, quite unlike the caseous material from a tuberculous abscess. Occasionally, such areas affect the skull, causing perforation of the bone with the formation of enormous sequestra and destruction of a large part of the cranial vault. When the gumma is in the center of the spongy portion of one of the long bones, there may be no clinical signs. In some cases, as when the gumma is in the lower part of the femur, secondary changes may appear in the knee joint. These will be similar to those found in cases of chronic arthritis and the detection of the true nature would depend on the recognition of a general syphilitic condition.

Osteochondritis

Osteochondritis may occur at the epiphyseal end of any of the bones but certain regions are more commonly affected than others. With such a variety of conditions as may arise, special names have been given to this disease in different parts of the body. Thus we have an affection of the upper epiphysis of the femur known as osteochondritis deformans juvenilis or Perthes' disease; an affection of the tibial tuberosity known as Osgood-Schlatter's disease; Kohler's disease of the tarsal scaphoid and also of the second metatarsus. More rarely, vertebral epiphysitis, epiphysitis of the os calcis and osteochondritis dissecans of Konig have been reported.

Perthes' disease is not frequently encountered, but six cases being present in one series of fifteen hundred hip cases of an orthopedic nature. It is four times as common in boys. There is usually a painless limp with little atrophy of the thigh muscles and little shortening. Flexion is unlimited but abduction is greatly interfered with. Both internal and external rotation are somewhat limited. There is no pain on palpation of the joint or on jarring the trochanter or heel, as in tuberculosis. Muscle spasm is not present. The x-ray picture, which is diag-

nostic, shows that the epiphysis of the head of the femur is flattened, irregular in outline and may even be broken into fragments. The epiphyseal line is indistinct. The whole pelvis of the affected side, as well as the upper part of the shaft of the femur, shows a decreased bone density and atrophy which increases during the first year. The course of the disease is self-limited, usually lasting from one to three years. In the terminal stage the x-ray shows the great regenerative power of the femoral head. The final form of the head may be of two types, the spherical and the mushroom shape. The former gives the best functional result.

Osgood-Schlatter's disease is a painful enlargement of the tibial tubercle occurring in adolescents, especially those receiving trauma in athletic sports. Hence, boys are more commonly affected (*Rugby knee*). It is the result of a direct blow or sudden strain when the knee is partially extended.

The condition is a subacute inflammation following a partial separation of the tibial tubercle.

In traumatic cases there is sudden pain over the knee, elevation of surface temperature, swelling, occasionally ecchymoses, and pain and tenderness when motion of the knee is attempted. In more chronic cases the tubercle enlarges more gradually so that the lower part of the ligamentum patellæ is pushed forward; pain is elicited when pressure is made over the insertion of the tendon. A slight limp is usually present.

Radiographic examination is of great value in showing an enlarged, tongue-shaped process which has lost its regular, definite outline, separated and projecting from the tibia.

A differential diagnosis must be made from disease of the bone or bursa. The prognosis is good. Most cases, when rest is given, recover spontaneously.

Kohler's disease of the *tarsal scaphoid* occurs between the ages of three and ten, and especially in boys. There are few clinical manifestations except pain and swelling of the ankle. On x-ray examination, the bone nucleus of the scaphoid is small, irregular and of markedly increased density.

Kohler's disease of the *second metatarsus* has seven cardinal signs, as follows: Changes of the base of the proximal phalanges, considerable broadening of the joint space, striking irregularity of the latter, flattening of the head, calcium bodies in the joint-capsule, thickening of the distal half of the metatarsal bone and disappearance of the neck. Clinically, there is localized pain, tenderness and later definite joint changes. This condition is found more frequently in girls.

Vertebral epiphysitis or *osteochondritis deformans juvenilis dorsi* occurs between ten and twenty, with clinical findings of fatigue, backache and tenderness at various points along the spine. A large number of the patients have a spinal deformity. The epiphysis becomes enlarged, ragged in contour and indistinct in outline; the superior and inferior margins of the bodies become ragged and the joint spaces cloudy and indistinct.

Epiphysitis of the os calcis is fairly common in boys between nine and thirteen. They complain of pain in the foot and heel after a slight trauma. Radiographic examination shows areas of rarefaction, alternating with areas of increased density in the os calcis and, at times, pathologic changes in the lower epiphyses of the tibia. The condition is thought to be due to local circulatory changes during the critical period of growth.

Osteochondritis dissecans of König is thought to be an aseptic necrosis of the epiphyses of the femoral condyles, following a mild injury. After the trauma, usually a jump or fall, the joint swells so that a true acute traumatic arthritis is present. When the arthritis has subsided, joint bodies may become pinched between the joint ends, and the joint may lock, throwing the patient to the ground. The free joint bodies are explained as the result of the pathologic compression fracture of the dead epiphysis with the formation of a bony débris.

Osteochondritis Syphilitica.—Occasionally, this disease is encountered during the first year of life, manifesting itself by an enlargement, mainly of the epiphyses, but also extending some distance along the shaft. Such an extension contrasts this condition from rickets. The disease is usually symmetrical, often multiple, affecting chiefly the knees, elbows and wrists. The ultimate result is cessation of growth in the bone.

Dystrophies

Chondrodystrophia foetalis or achondroplasia is a disease of bone in which there is a failure of development due to a disturbance of the zone of growth in the cartilage at the epiphyseal line. The condition is not common; it is congenital in origin, often found in stillbirths; others affected may die very young. Associated congenital deformities such as cleft-palate, hernia or dislocation of the hip are frequently present.

These patients have a characteristic appearance, being dwarfed with arms and legs shortened and slightly bowed and the body somewhat shortened. The bridge of the nose is retracted due to the disproportion in growth of the membranous and cartilaginous bones; the skull bones are not affected and the mental condition is normal. There is a prominence of the abdomen (pot-belly). The long bones are shortened and curved, the hands and feet short and spade-shaped, the fingers practically all of one length so that Marie has applied the term “*main-en-trident*.” The joints are very mobile and the epiphyses enlarged, simulating rickets.

Osteodystrophia cystica is a term first used by von Mikulicz to describe a condition in which there is a perverted growth of bone and marrow. The osteoclasts are overactive and connective tissue elements develop to an excessive degree in the marrow. There is a disturbance between bone formation and absorption. Irregular cysts form in the bone, commonly in the humerus, leading to spontaneous fracture which may be the first symptom.

Diseases

Barlow's disease (*infantile scurvy*) occurs in infants, principally after the sixth month, and is associated with improper diet, chiefly in the form of proprietary foods. The disease is characterized by swellings about the larger joints, and remarkable tendencies to bleeding in the mucous membranes and subcutaneous tissues. Swelling is usually observed in the lower extremities, especially about the epiphyses of the long bones at the knee and ankle joints, but may occur in other locations as well. Extreme tenderness accompanies the swellings, which may be noticed over the shafts of the long bones, where subperiosteal hemorrhages are frequent. There is also a disposition on the part of the patient to refrain from muscular movements, suggesting a paralytic condition. The gums are spongy, deep red or reddish-blue in

color, and bleed easily; subcutaneous ecchymoses are sometimes visible beneath the skin. More rarely hemoptysis, hematuria and melena occur. Advanced cases exhibit marked disturbances of nutrition. The combination of swollen, tender epiphyses, spongy, bleeding gums, subcutaneous ecchymoses and improper diet is quite diagnostic.

Rickets (*rachitis*) is a nutritional disturbance of infancy, resulting in alterations of the density and alignment of the long bones, and frequently producing bony deformities.

The general symptoms include gastro-intestinal disturbances, secondary anemia and decrease in weight and strength. Pallor is usually present, the spleen is often enlarged, the abdomen is of the "pot-belly" or protuberant type, and symptoms and signs of scurvy may be associated.

Anatomically, however, the principal changes are noted in the bones, because of disturbances of calcium metabolism. While the long bones present the most striking abnormalities, the flat bones of the skull are also involved, and a box-like appearance of the skull with high forehead and prominent parietal bosses is a constant finding. Craniotabes is often associated in early or controlled cases, and enlarged epiphyses, particularly at the wrist and ankles, are, as a rule, noted. In more marked instances, bow-legs, knock-knees, and deformities of the ribs are encountered. The changes in the ribs take place at the chondrocostal junctions, so that a series of nodular enlargements are visible and palpable at these sites; hence, the designation, *rachitic rosary*. In later stages there is flattening of the chest, the cartilages bulging forward from their junctions with the ribs to form an unusually pointed or pigeon-breast deformity.

In the upper extremities, the long bones may exhibit distortions similar to those of the lower, such as bowing and markedly enlarged epiphyses at the elbows and wrists.

In unretarded cases of rickets the vertebral column and pelvis are also affected, and are increased materially by weight-bearing. The typical vertebral deformity is a kyphosis, although lateral curvatures are not uncommon. The pelvic bones become grotesquely deformed and the pelvis is flattened in its anteroposterior diameter.

Acromegaly is an acquired disease of adult life, dependent upon an affection of the pituitary gland and manifested by changes in the bones and soft tissues. It is extremely slow in onset and chronic in its course.

Attention is drawn especially to the protruding lower jaw and the unusually large size of the hands and feet. Closer inspection will reveal that the skull and face are also altered so that the patient's face appears elongated and the head and face enlarged with a prominent and widened lower jaw. The frontal bones about the orbits are definitely overgrown, seeming to push the eyebrows forward; the nose and lips are thickened, and the skin is coarse. Pigmentary changes in the skin also occur. At times, the eyeballs are prominent and the voice becomes gruff and coarsened. Sexual impairment is common. In addition to these, glycosuria, vascular changes and nervous manifestations may be noted, and severe headache is a common complaint. Radiography is of value in demonstrating changes in the sella turcica.

When the pituitary body is hypertrophied, acromegaly may continue for years.

When affected by glioma or sarcoma, the course is more rapid and symptoms of an intracranial tumor may be imposed upon those directly attributable to the glandular disturbance.

Osteomalacia, a rare disease of the bones, occurs chiefly in females and usually in association with pregnancy. The earliest symptoms are pains in the back and difficulty in walking. Deformities of the pelvis, spine and ribs take place, because of the softness of the bones and the absorption of lime and calcium salts. The body becomes shortened, the spine kyphotic and the pelvis narrowed from side to side with a pointlike pubic region and flaring iliac crests. Later, the bones of the lower extremities bend under the superincumbent weight, assuming twisted, grotesque shapes, and the patient is bedridden and emaciated. Changes in the ribs frequently affect the breathing. Neuritic pains are common. Improvement may occur with the termination of a pregnancy, and recurrences are common when pregnancy supervenes.

In the male, osteomalacia is usually first evident in the lower extremities, and may be confined to those locations. The disease is very rare in the male.

Fractures occur, although bending or bowing is more frequent.

Osteosclerosis Fragilis Generalisata.—Several names have been applied to this disease, such as Marmorknochen (marble bone), Albers-Schönberg disease, fragilitas ossium, osteopsathyrosis, osteogenesis imperfecta and idiopathic psathyrosis. Griffith reserves the name *osteogenesis imperfecta* for cases of multiple intra-uterine fractures, together with imperfect development of membrane bone. Albee also uses this same term to include a like condition in infancy and childhood. Hess has coined the terms *osteogenesis imperfecta congenita* and *tarda*. Regardless of the exact name, all of these conditions have many characteristics in common.

Nickols divides fragilitas ossium, which he claims is a clinical condition and not a disease, into two groups: (1) "Symptomatic fragility," in cases with rickets, osteomyelitis, tabes, tuberculosis, syringomyelia, paralysis, malignant tumors and cysts; (2) "idiopathic fragility," which he considers identical with osteogenesis imperfecta. Ostheimer describes two types of cases: (1) The fetal type found either at birth or shortly thereafter, the patients frequently not living over one year; (2) the congenital type, found in infants and children, at birth or later, with fractures recurring often until puberty or even adult life. Although a fairly large number, about two hundred, of these bone conditions have been reported they are not at all common. In 1,610 cases of fracture of the long bones at the Massachusetts General Hospital, only two cases were due to fragilitas ossium. These statistics show the rarity of this condition.

The etiology of any of these pathologic states is unknown. Heredity seems to be the only common finding. In 10 per cent of cases, the same trouble is found in a relative of the patient. Males and females are affected in nearly equal proportions. Some writers note an increased frequency in persons with *blue sclerae* but the relationship is not clearly known.

Patients affected with any of these bone conditions often have a relatively large head, small chest and protuberant abdomen, but such findings are very inconstant. The greatest common characteristic is fracture of the bones following some minor injury. These breaks are frequently intraperiosteal with little displacement of fragments; they may be multiple and are almost painless. The lia-

bility to fracture decreases with age so that after thirty they are rare. The long bones are usually affected, the femur most frequently. The fractures unite slowly, sometimes with a minimal formation of callus; at times, with an excessive amount of inferior, porous callus. Deformities are the rule, often making the patient short in stature. Curvatures may occur independent of the fractures.

Radiographs usually show a cortex of bone of irregular thickness, on the whole very thin, in some places even appearing to be absent. The spongiosa contains wide meshes and absence of structural markings. The medullary cavity is increased in size and shows an irregularly mottled shadow. The epiphyseal cartilages and their centers of ossification are larger than normal. The cases of marble bone (*Marmorknochen*) give an x-ray picture in which the bone structure is not recognizable. The bones give deep black shadows, with the medullary cavity lacking and cortex diffused; a picture, indeed, suggesting an unusually pronounced calcification of the whole skeleton. Especially characteristic is the appearance of parallel bands of lime in the diaphyses of the bones of the hands, feet, fibula and ribs.

The prognosis depends on the age. Most intra-uterine cases die at birth or shortly afterward. Should the patient survive, the liability of fractures is gradually outgrown but never entirely lost. Deformities, curvatures, and malunion are almost always present.

Aneurysm

Aneurysm of bone is an inaccurate clinical term, which may apply to several conditions, but is usually used to describe a pulsatile bone tumor. De Quernain states that blood-cysts of the long bones which are not obviously sarcomata have been termed aneurysms. These consist of a thin shell of cortex enclosing a collection of blood. No distinct tumor is found, but the inner layer is made up of tissue resembling bone-marrow but containing many giant-cells. Such a condition has been ascribed to injury, inflammation or a real tumor. The disease is unnoticed until a spontaneous fracture occurs at the site of the aneurysm. Haas, on the other hand, considers such conditions as an advanced form of telangiectatic bone sarcoma, in which the tumor tissue has been reduced to a mere cortical shell; hence, there is early metastasis and a bad prognosis. It is evident that these two authors are describing different diseases, and that aneurysm should be used only as a descriptive term.

Exostoses

Exostoses are benign growths of bone which usually appear about the epiphyses in young people and may be found at any point along the shaft. As the bone develops they are commonly multiple. For a time the outgrowths are partly cartilaginous, later bony. Heredity is supposed to be a factor. The masses are irregular, often rather thin, sharp outgrowths and later in life may result in old fractures or inflammatory conditions. They may interfere with motion because of their large size or proximity to joints. When similar growths occur in the bone, they are termed enostoses. When there is a diffuse thickening of the bone, the word hyperostosis has been used.

Osteitis Deformans*(Paget's Disease)*

The origin of this disease is still unknown. It may be described as a definite clinical entity, however, and is characterized by various deformities of the bone, most especially affecting the skull and long bones, and of various subjective symptoms, most of which are of a minor nature. According to Lewin (*J. Bone & Joint Surg.*, 1922, p. 49) the average age of onset is about *forty-nine and one-half years*, though occasionally younger individuals are affected. *Males* are more prone to the disease and there appears to be an *hereditary* tendency. The *bones* most *frequently involved* are the tibia and femur, though the skull and clavicle often show evidence of the disease. The hands and feet play a prominent part in the bone involvement, and the humerus, radius and ulna occasionally show characteristic changes. The *onset* is insidious and may extend over many years, the *prodromal symptoms* being those of an indefinite "bone aching," so often spoken of as "rheumatoid pains" accompanied by a gradual weakness and instability of the legs with bony tenderness of the shafts. Occasionally, the increase in the size of the head is the first presenting symptom. As the *disease progresses*, the head usually becomes flexed, causing the chin to approximate the breast bone and a definite cervicodorsal kyphosis may develop. The tibia and femur become thickened and the deformity of outward and forward bending of these bones is common. The arms gradually increase in size, the chin may become of a "prognathian type," the abdomen often becomes diamond shape, from ensiform, symphysis pubic and the costal angle (Lewin), and swellings and hideous deformities of the metacarpal bones and phalanges may ensue. Bony deformities are *usually symmetrical*. A *gradual decrease in stature* is one of the diagnostic signs and an *anthropoid ape* appearance of the patient is not uncommon. The patient gradually becomes unsteady, more or less apprehensive and disgruntled and symptoms of a *mild intoxication* may develop. *Lewin's differential symptom* of this disease as opposed to osteomalacia should be considered: "When a patient with Paget's disease grows smaller—he is small all day long but osteomalacia has a diurnal cycle, due probably to compression and relaxation of the intervertebral disks, causing patient to be taller in the morning than at night."

Radiographic findings are typical, showing a rarefying osteitis with thick cortex due to subperiosteal and medullary new bone formation, the thickening occurring on the convex surface.

Cysts

Bone cysts occur as a complication of many diseases of bone. Bloodgood, as reported by Boyd, gives a list of such diseases, as follows: Osteitis fibrosa cystica, multiple chondromata, myxoma, giant-cell sarcoma, osteitis deformans, subperiosteal hematoma, callous cysts, bone abscess, echinococcus cysts and osteomalacia. Ashhurst classifies bone cysts as due to: (1) Infections, osteomyelitis, tuberculosis, syphilis; (2) dystrophies; (3) tumors. The relation of cysts to these many conditions will be considered in their separate descriptions. We will discuss here only that condition of non-malignant cyst formation, osteitis fibrosa cystica.

Osteitis fibrosa cystica was first described by von Recklinghausen in 1891 and hence is sometimes called by his name. It is a distinct, benign, central lesion of the bone occurring in a localized or generalized form. The localized form is the one most commonly encountered, having a close relation to cysts of a single bone. The generalized form is rare, there being only about forty cases in the literature. The etiology of either form is not definitely known. Bloodgood believes it to be of an inflammatory nature, a low-grade osteomyelitis. Others think there is a disorder of calcium metabolism and ossification, while still others hold trauma to be an important cause. Morton has made a very minute, inclusive grouping of all the types of cases, discussing the etiology, symptoms, course and prognosis of the cysts in relation to their occurrence with or without giant-cell sarcoma, fibrosis, malacia and hyperostosis. Briefly, his group with multiple cysts, without giant-cell sarcoma, with fibrosis and malacia confined to a few bones, occurs in young people under thirty, runs a chronic course and may exist for years without change in character. A pathologic fracture is the most common manifestation, this leading to the discovery of the disease. Sometimes there are slight pains of a rheumatic nature. There are no fatalities in this group. In contrast to this, the second group, where there are the same pathologic conditions but with a predominant general malacia, includes causes with a very bad prognosis, death being the result in almost every instance. It occurs at a later age, the predominant characteristic being a softening of the whole osseous system. The symptoms include marked pain, numerous fractures, increasing deformities, helplessness, anemia and emaciation. The third group, as above but with hyperostosis, includes cases with a typical deformity in which the head is bowed down and forward, chin on the chest in severe cases; thorax pigeon-breasted, and vertebrae crushed together, causing a kyphosis. The patient sinks together so that the arms are disproportionately long, giving the appearance of an anthropoid ape. The fourth group, one with giant-cell sarcoma, is much less frequently encountered, and has symptoms of swelling, deformity and fracture. Local recurrences are common, but there is no tendency to metastasis.

As a whole, in all the types of osteitis fibrosa cystica, there is a general and diffuse degeneration and absorption of bone with growth of the vascular connective tissue. There is no change in the soft parts; the periosteum is easily freed, disclosing a grayish white cortex with the appearance of a lowered vitality; the cortex may be easily crushed. The bone loses its hardness, becoming so soft in the late stage that it may be cut with a knife. There is a tendency toward the formation of cysts, the content of which is a thin gelatinous fluid, from yellow to red in color, depending upon the amount of blood. The cyst or defective part of the bone is often filled with a tumor-like tissue which microscopically resembles giant-cell sarcoma, but which is not malignant. Clinically, the main symptoms are pain, swelling, deformity and spontaneous fracture. Pain is rarely severe, being usually of a rheumatoid type. Very slowly, over a period of years, the bone may swell, partly because the main cyst increases in size, and partly because of profuse growth of tissue containing giant-cells. Cysts may be formed without any swelling of the bone. Irregular, angular deformities due to bending of the softened, long bones are common. Spontaneous fracture is most commonly the first manifestation of the disease, being brought on usually by a slight trauma. The frac-

ture may be accompanied by but little pain. The disease most frequently attacks the humerus, femur and tibia in the order named. The pathologic fractures, as a rule, heal well because the periosteum is usually spared.

A radiogram in a case of osteitis fibrosa cystica shows the surrounding tissues uninvolved and no change in the periosteum in the majority of cases, never more than a slight thickening, the structural change being confined within the cortex of the shaft. The cortical bone is irregular, mottled, thin, and in some places even destroyed. The lesion is metaphyseal, never epiphyseal. Bowing of the shaft is common. The cystic pockets are separated by trabeculae of compact bone and are clean cut, differing in this respect from sarcoma. The marrow cavity is widened, irregular and mottled in places. The diminished calcium content gives a general translucence to the bone.

Conditions to be differentiated from osteitis fibrosa cystica are giant-cell sarcoma, myxoma, chondroma, osteomalacia and Paget's disease.

Tumors

BENIGN

Fibromata are uncommon. They generally arise from the periosteum. They are found for the most part about the skull and face, though they may form from any part of the bony framework. Not infrequently they emanate from the alveolar process. They are usually fairly hard, circumscribed, at times freely movable masses, usually pedunculated and painless, unless pressing upon some nerve or nerve plexus.

Chondromata are of common occurrence and may appear as external protuberances or as medullary masses. Though they may appear in any part, they are most often noted in the hands and at the ends of bones, especially about the knee joint. An hereditary predisposition seems to be a factor. The external masses that form are either single or multiple, hard, nodular and fixed, usually painless and may or may not be conglomerate. The medullary type may grow from within, outward, causing distortion of the bone, perforating the cortex, and assuming the same picture as those originating from the cortex. Degeneration into myxomatous and sarcomatous masses is common.

Osteomata are true bony tumors generally of periosteal origin. When they form hard bony masses, not invading the inside of bone and apparently originating from the cortex, they are classified as "exostoses." They are hard, fixed, painless (unless pressing upon a nerve), non-sensitive to pressure, regular or irregular, with a tendency toward being single and, at times, causing impairment of function due to size and position. The osteomata tend toward invading the inside of the bone.

For so-called "benign sarcomata," see Differential Chart.

MALIGNANT

Carcinoma.—Schmorl of Dresden, in an extensive study, found that "no less than 34 per cent of all cases of cancer coming to autopsy exhibited metastases in bone." In the light of these statistics it may be seen how frequently this lesion

Disease	Progression	Pain	Description
Ossifying hematoma	Usually follows <i>trauma</i> . Immediate localized swelling. Lime salts are deposited very slowly.	Usually none.	If sufficiently large, single slightly elevated regular mass (rounded). Hard and fixed.
Chondroma	Slow growth remaining dormant for months or years, then growing rapidly, due to some form of trauma; and usually takes on the picture of osteogenic sarcoma.	Slight on pressure.	May produce considerable deformity, if large. The shapes are so various that it may present as a circumscribed or markedly irregular mass. Enlarged veins (usually) over mass. If large, covered by bursa with freely movable skin over mass. All varieties of shapes, hard and fixed. Usually single.
Osteogenic sarcoma	As disease progresses, the pain becomes more intense; the growth becomes evident and pain may disappear for a short time, to become more aggravated especially after slightest trauma. Pathologic fracture may develop or metastases occur. General health remains good until late stage, even though patient may present a chalk pale appearance. A tired, more or less dragging feeling in joint, in neighborhood of disease, causing a definite limping which may precede the severe pain over affected area. Severe pain in affected part may be first symptom.	First symptom, preceding detection of growth. <i>Severe and persistent pain in a long bone of a young adult</i> ; most important. At night increased. Pain usually of a boring, gnawing type. May disappear after perforation of tumor. May be intermittent.	Skin overlying tumor, stretched, and thinned, though <i>no ulceration</i> . Temperature of skin over diseased area, high. Early dilatation of veins in pale white skin over and in neighborhood of growth. At times, skin tense, glossy and in later stages of a purplish tint. If markedly inflamed excoriation may present (rare). Mass if perceptible appears as a regular swelling. Repeated palpation, necessary owing to change in form of mass. Mass usually regular, may be irregular, hard and fixed. At first skin is fairly freely mobile over it, but this is very soon replaced by adheserency of all overlying tissues. "Crackling" of mass is rarely elicited. May be deep tenderness. Possibly pulsation and bruit. Often fusiform in shape.

OF BONE TUMORS

Part Involved	Roentgenology	Special Data	Disease
Especially, diaphysis.	Clear-cut outer margin as ossification becomes complete. Bone deposited longitudinally with shaft.		 Ossifying hematoma
Usually long bones at epiphyseal line.	Cystic locular appearing tumor, usually within cancellous bone at epiphyseal line with invasion of the epiphyses and irregular trabeculations of bony or calcareous deposits. Clear-cut outline—no periosteal thickening.	Local recurrence, common. At times becomes malignant.	 Chondroma
Especially in <i>metaphysis</i> of long bones of lower extremity. In majority of cases, tumor is located about knee (femur or tibia). In about 10.5 per cent the upper extremity is affected.	Both medullary and subperiosteal involvement. Radiographs show presence of old cortex or fragments of it in normal position. No definite limited outline of sarcomatous tumor. Spindle shape common. Shaft passing through tumor mass, grossly intact.	Twice as many primary <i>malignant tumors</i> as benign <i>giant-cell tumors</i> . When joint becomes involved, it becomes fusiform in shape. X-ray lungs, In early sarcomatous metastases, no bone production is present (usually) and <i>shadow is only faintly outlined</i> . Patient is in good health before onset of symptoms. Considerable degree of free motion in joint. Metastases to lungs, common. Regional lymph-gland involvement signifies more for generalization of malignancy than in carcinoma. Joint pain not a prominent feature. Cochran says that in any patients over fifty who do not have coincident Paget's, we may <i>not</i> suspect a case of osteogenic sarcoma. Hyperleukocytosis with increase in lymphocytes accompanies febrile period. At times small number of myelocytes.	 Osteogenic sarcoma

Disease	Progression	Pain	Description
Giant-cell tumors	Usually covers a period of years, and is of slow growth unless explored. It may then rapidly increase in size.	Frequent and early, not so severe as in osteogenic sarcoma. More persistent after radiation. Often intermittent.	Bulky spheric shape of tumor on area involved, on diaphysis. If shell is thin, may get eggshell crackling. If very vascular may feel bruit. Usually dilatation of veins not present, When large tumor, skin is stretched, swollen and of a bluish discoloration. Ulceration only, in very advanced cases. Single.
Endothelioma (Ewing's tumor)	Incipient attack. Trauma usually at or near seat of tumor followed by intermittent pain of long duration and swelling. Even after slight trauma followed by onset of fever. <i>Intermittent</i> limping due to recurrent bone pain with only a slight or no leukocytosis. Each attack is of longer duration, with more severe pain, and intervals become shorter though patient may be up and around for a year or more. Intermittent type common. A constant part of history more intermittent than in osteogenic sarcoma. As each attack comes on pain becomes more intense, radiating over entire affected limb.	+	Irregular protrusion. Skin freely movable over involved area, excepting in rare cases of a markedly advanced stage. Exploration usually leads to a persistent sinus though at times incision heals; ulcerating with fluctuant growth. Multiple. No joint involvement. Shaft and epiphyseal ends of long bones. Very widespread involvement of shaft. Very rarely is epiphysis affected. If spine is involved, more than one vertebra. Skull, ribs—any bone. In order of frequency tibia, fibula, humerus, ulna and femur. Any bone. Repeated palpation necessary owing to change in form of mass, especially after radiation. Hard, regular or irregular fixed swelling tender to touch.

BONE TUMORS (Continued)

Part Involved	Roentgenology	Special Data	Disease
Registry of bone sarcoma finds the following: Bones of lower extremity, 56 per cent; of upper extremity, 23 per cent; of trunk, including pelvis and shoulder-girdle, and jaws, 21 per cent; of upper extremity, radius involved in 40 per cent and all in lower end of bone; of lower extremity, lower end of femur and upper end of tibia in about 47 per cent, jaws about 9 per cent, spine 8 per cent. Small bones more frequently involved than in osteogenic sarcoma. Epiphyses involved in large majority of cases. Joint involved early.	Characteristic bulky, spheric shadow with multicystic appearance. Shaft of bone absent, cortex distended to thin shell. Bone shell limits tumor from adjoining normal medullary cavity.	Tumor extends to direct contact with articular cartilage; an important differential point from osteogenic sarcoma.	Giant-cell tumors
In early stages a diffuse involvement of the bone, usually of <i>diaphysis</i> and not the ends. Involvement of about half length of bone. Shaft slowly displaced by tumor mass. Smooth bone absorption is accompanied by widening of shaft with frayed longitudinal trabeculae. Destructive roughening of periosteum. New bone laid down parallel to shaft.	See "part involved."	Enlarged regional lymph glands; sign of inflammation or metastases. Tumefaction arises suddenly with signs of local hyperemia and inflammation. In beginning tumor may grow slowly. It may entirely disappear, but return in next attack larger in size. Then growth becomes more rapid and continues to grow until fatal termination. Pathologic fractures not common except in terminal stages. Use radiation as diagnostic test. Occasionally an intermittent rise, temperature lasting for a few days and disappearing for days, weeks or months before recurring. In last stages high rise is common and in pulmonary involvement.	Endothelioma (Ewing's tumor)

Disease	Progression	Pain	Description
Multiple myeloma	Gradual weakness and loss of weight with intervals of apparent regaining of health. Traumatism considered. May be slow or fairly rapid.	Often periodic, at first, with intervals of freedom. Usually of "rheumatic type."	May be bony protuberances and shortening of stature, due to spinal curvature. Soft, somewhat elevated, tender masses, often palpable if sternum, ribs or clavicle involved. Fixity; may be crepitation of mass, perhaps an enlarged spleen and general lymphatic hyperplasia of regional nodes. Multiple.

* Free use has been made of the monograph, by Anatole Kolodny (Codman), *Bone Sarcoma*

is found as a secondary condition to a carcinoma elsewhere in the body. Extension to the bone may take place (1) by direct extension of a primary tumor, *i.e.*, breast to ribs, lip to jaw bone, etc., and (2) by extension usually through the blood, rarely through the lymphatics, *i.e.*, from prostate, uterus, hypernephroma, etc. In those cases of direct extension the signs and symptoms of the primary carcinoma may entirely veil the secondary growth. On the other hand, an extensive carcinoma of the bony framework may present with few or no apparent signs or symptoms emanating from the primary lesion. Pain is very often markedly increased after the bone has become invaded.

In the metastatic type, the signs and symptoms may be dormant over a long period of time and a spontaneous fracture is often the first sign of bone invasion. Metastatic carcinoma of the bone may involve one or all bones. There is usually no change in the outline of the bone, unless spontaneous fracture occurs, and even when the spine becomes extensively involved, several bodies perhaps being invaded, there is no collapse of the column owing to the considerable support of the dense tumor tissue. On the other hand, there are metastatic bone cancers, which are characterized by extensive production of new bone in the neighborhood of the growths, especially in the spine and pelvic bones; the bone becomes enlarged and the symptoms are mistaken for those of osteitis deformans. The

BONE TUMORS (*Concluded*)*

Part Involved	Roentgenology	Special Data	Disease
Most especially involving ribs, sternum, vertebræ and skull. When in long bones, favors midportion rather than ends.	Absence of bone production but complete absorption of bone within tumor, producing "clearcut, round, multiple, central areas." As tumors grow cortex, periosteum and epiphysis become invaded.	Bence-Jones bodies in urine. Marked albumosuria, otherwise apparently normal urine. Recedes rapidly (not) permanent unless radiation. No typical blood-picture; occasionally increase in myelocytes. Incipient fever soon replaced by subnormal temperature. Early <i>cachexia</i> and <i>anemia</i> . May be paralysis due to vertebral involvement. May be pain in chest due to rib or sternal involvement. Fractures occasionally occur on slight pressure. Always include x-ray of skull. Of recurrences and extensions it is difficult to determine whether they are metastases or multiple primary new growth. Always fatal two to five years.	 Multiple myeloma

(Chicago, Surgical Publishing Company, 1927).

radiograph will easily distinguish the condition, and it should be remembered that osteitis deformans more commonly attacks the long bones and the skull but rarely involves the spine; this second variety of carcinoma shows preference for spongy bone. It should always be borne in mind that constant pain in various parts of the bony framework of the body, especially in the spine, in patients suffering from cancer, should always be looked upon with suspicion.

Sarcoma.—See Differential Chart, "Bone Tumors."

Myeloma.—See Differential Chart, "Bone Tumors."

AFFECTIONS OF THE VERTEBRAL COLUMN

Congenital and developmental anomalies	{	absence of one or more vertebræ	
		supernumerary vertebræ	
		rudimentary transverse processes	
		cervical rib	
		sacralization of the fifth lumbar vertebra	
		narrow intervertebral foramina	
		incomplete neural arches	
	{	spina bifida	
		rudimentary bodies	
Inflammatory conditions	{	acute {	epiphysitis
			osteitis or osteomyelitis
		chronic {	osteo-arthritis
			osteitis or osteomyelitis
Granulomata	{	tuberculosis (Pott's disease)	
		syphilis	
		actinomycosis	
		blastomycosis	
Typhoid spine			
Gonorrheal spondylitis			
Spinal curvatures	{	scoliosis	
		lordosis	
		kyphosis	
Spondylolisthesis			
Malnutritional diseases, and so-called dystrophies			
Rickets			
Osteomalacia			
Acromegaly			
Pseudohypertrophic muscular paralysis			
Chondrodystrophia			
Osteitis deformans			
Aneurysm			
Hysteria and neurosis			
Tumors	{	primary	
		secondary	

Normally, the human spinal column contains thirty-three vertebræ, seven cervical, twelve dorsal, five lumbar, five sacral and four coccygeal. In the first

three regions each vertebra is a distinct unit, separated from its neighbors by interposed cartilaginous disks, and articulating with each other by means of apposed facets; the whole being bound together by dense and powerful ligaments and further supported by sturdy muscles disposed in various planes. In the sacral and coccygeal regions, the vertebrae are fused, and are no longer segmental. The column, as a whole, describes a gentle S-shaped curve; renders support to the cranium above and terminates distally in the coccyx, to form the posterior boundary of the pelvic outlet. In the dorsal region, the ribs articulate with each vertebra to enclose the important thoracic contents; while the fused, non-mobile sacrum is wedged between the pelvic bones and aligned therewith by unusually strong ligaments to form a synchondrosis. The vertebrae of the cervical, dorsal and lumbar regions are provided with posteriorly projecting spinous processes which extend obliquely downward in the cervical region, and also in the dorsal, and become approximately horizontal in the lumbar region. The tips of these lie beneath the skin and are palpable throughout, so that the vertical alignment of the vertebrae can be noted by inspection and palpation. The flat wide sacrum and the tail-like coccyx are also subcutaneous and can be easily palpated there, and by rectal examination. The spaces between the bodies of the vertebrae are least in the cervical region and greatest in the lumbar region; and this is also true of the spaces between the tips of the spinous processes, excepting for the mid-dorsal region where they are in close approximation. The seventh cervical vertebra is the most prominent of all; its spinous process is palpable in all people; and a given vertebra can be accurately identified by counting from this landmark. The fourth lumbar vertebra is located at a point in the midline of the back, on a level with a transverse line joining the posterior superior spines of the ilium.

Technic of Spinal Column Examination

The patient should be completely stripped and examined in a good light. He is first viewed from the back, noting the apparent alignment of the spinal column, as indicated by the central groove bordered by rounded muscular masses; the vertical relationship of the head and neck to the trunk, the position of the shoulders; the scapulæ, especially their angles; the position of the iliac crests and posterior superior iliac spines; the attitude of the patient in general; the shape of the loins; the location of the gluteal folds; the stance and position of the feet. He is then viewed from the front, noting the position of the head and eyes and that of the chin; the apparent length and contour of the sternomastoid and trapezius muscles; the position of the shoulders and the line of the clavicles; the shape and symmetry of the chest and abdomen; the relative locations of the infracostal grooves and superior iliac spines and crests; the inguinal and femoral folds; and the extremities for old injuries or deformities. Next, the patient is viewed in profile from both sides, noting differences in the muscular masses which border the vertebral column; the posterior levels of the scapulæ; the shape of the chest and abdomen and the relation of the trunk to the pelvis and lower extremities below, and to the head and neck above.

Again viewing the patient from the back, he is required to walk. The gait, general attitude, mobility of the spine and pelvis are observed. With the heels together,

he is required to bend the trunk forward as far as possible; backward and to either side; and then with the pelvis and lower limbs fixed, to rotate the trunk. These motions should also be performed against the resistance of the examiner; and should be repeated while the examiner's hands test the paravertebral muscles for spasm and resistance. Alterations in mobility and contour of the spine will be best appreciated if the examiner first runs three fingers rapidly over the spine from occiput to sacrum, the middle finger coursing over the tips of the spinous processes, thus producing a superficial erythema which will readily mark the spinal alignment.

The spinous processes are then accurately outlined, from above, downward, each in relation with its neighbors, by palpation. Tenderness may be elicited by pressure with the finger tips or by percussion. It is sometimes advantageous to percuss with the body bowed forward. With gross malposition of the spinous processes, the vertebral bodies may also be palpated, if the individual is not too fat or muscular. Pressure is made over the sacro-iliac joints and the wings of the pelvis are crowded together manually to test the condition of these joints. The sacrum and coccyx are outlined by palpation, and digital examination of these structures is made by rectum or vagina. In selected cases, the effect of jarring on the heels may be tried; and, very cautiously, direct jarring of the spine by means of the closed fist. The patient should be required to pick objects from the floor and his movements carefully observed during this procedure. This is of great value when dealing with children and occasionally will catch a malingerer off guard. When apparent pressure tenderness is found, look also for acceleration of the pulse—*Mankoff's sign*.

The limbs, trunk and pelvis are thoroughly inspected and palpated not only for bony deformities, but also for muscular action, points of nerve tenderness and for the condition of the *arches* of the feet. Skin, pupillary and tendon reflexes must be tested and in some cases it will be necessary to test the sensations also. Romberg's sign should also be sought.

The patient is required to lie in the dorsal decubitus on a flat hard surface, noting any departures from the normal in this position. In lower spinal affections, motions of the lower extremities with and without resistance, and both active and passive, are thoroughly tested, not neglecting the effect of forcible extension of the leg after the thigh and leg have been completely flexed. He is then asked to lie prone, again inspecting and palpating the spine, testing thoroughly the muscular functions and palpating for muscular spasm. This may be brought forth by passive extension of the limbs, and at the same time will determine the mobility of the lumbar spine. The best illustrative method in children is to grasp both legs near the ankle, raising upward and attempting extension of the pelvis upon the movable portion of the spine; muscular spasm will prevent such motion and the trunk will also be raised, since the affected portion of the spine thus becomes fixed. The effect of transmitted jarring can be ascertained while in this position by striking the soles of the feet near the heels with a closed fist, a procedure which is not always justified.

In conducting the examination, one should analyze the temperament and emotional reactions of the patient and be influenced somewhat by coöperative and obstructive tactics. It is of advantage to note the facial expression while the various steps of the investigation proceed. In no field will more instances of neurosis and malingering be met with; on the other hand, in no condition can injustice be

inflicted upon a patient so readily as by an incomplete or inefficient examination. Complete physical and neurologic examinations will frequently be necessary since spinal affections are frequently symptomatic; since the proximity of the spinal cord often produces referred symptoms and conditions; and since vertebral deformities lead to other somatic and visceral alterations. In modern day practice, especially in medicolegal cases, radiography is a vital adjunct in diagnosis, prognosis and as a guide to further treatment.

Congenital and Developmental Anomalies

In recent years, because of the widespread use of the radiograph in back conditions, congenital anomalies of the vertebral column are becoming more widely recognized and their occurrence is no longer regarded as uncommon or theoretical. Some of these exist without symptoms, while others simulate various spinal cord affections. Most of them cannot be detected by ordinary examination. One, or rarely two, vertebræ may be *absent*. This happens particularly in the lumbar region. The opposite condition, *supernumerary vertebra*, sometimes occurs chiefly in the lumbar and thoracic regions. These, of course, add to the stature of the individual. Occasionally, *transverse processes* are *rudimentary*. These do not give rise to symptoms. In contrast with this, one or both transverse processes may be unusually long. In the cervical region, a unilateral or bilateral *cervical rib* is thus formed. A cervical rib may cause no symptoms or it may produce them by pressure upon the adjacent nerves and blood-vessels. It can sometimes be palpated. In the lumbar region, long transverse processes of the fifth lumbar vertebra may extend laterally to the ilium, interfering somewhat with the motion of the lumbar spine. This is known as *sacralization* of the fifth lumbar vertebra, since thereby this vertebra becomes fixed instead of mobile, and is thus analogous to the sacral portion of the spinal column. The *intervertebral foramina* may be unusually small in caliber, thus impinging upon the nerve trunks, and producing symptoms of nerve root involvement.

The neural arches may be the source of congenital anomalies, in that they are sometimes incomplete. This failure of closure, or faulty development, may exist without symptoms, or may be associated with spina bifida.

The bodies of the vertebræ may also be rudimentary. Such an affection is very likely to be associated with other congenital spinal deformities, such as scoliosis. In addition to its being poorly developed, the body is usually malformed, as well. Frequently, in such conditions, congenital malformations exist in other regions.

Inflammatory Conditions

Acute epiphysitis occurs in young people, after the tenth year, and is associated with kyphosis, vertebral tenderness, back pain and fatigue. The symptoms and x-ray findings usually disappear after a period of enforced rest.

Acute osteitis, or *osteomyelitis*, is characterized by sudden back pain, which is aggravated by motion and which soon becomes disabling; voluntary motion is greatly restricted even at the onset. Tenderness over the affected area is noteworthy. The usual swinging temperature of bone infections accompanies the condition. Soft tissue abscess, perhaps preceded by edema, is fairly common, and usually

occurs relatively early after the initial symptoms. The x-ray picture, leukocytosis and above mentioned symptoms are diagnostic. The condition is uncommon.

Acute osteo-arthritis occurs as a complication of some of the acute diseases. Among these are cerebrospinal fever, typhoid fever, tonsillitis and diphtheria. Any region of the spine may be affected, and two or more vertebræ are, as a rule, involved. The onset is acute, with pain in the spine and increasing difficulty in movements of the spinal column. Local tenderness can sometimes be demonstrated. Under proper treatment the majority of the acute osteo-arthritic affections subside. Occasionally, however, the acute form represents the onset of a chronic condition which is progressive and sometimes disabling. The radiograph is a valuable aid in diagnosis.

Chronic osteo-arthritis occurs at all ages as part of a generalized polyarthritis. It also occurs as a localized affection. The disease may follow trauma. It is also common in laborers of middle age. In some cases, the osteo-arthritic changes are limited to a certain region, most frequently the lumbar; while in others, progressive alterations of the greater part of the spinal column are to be noted. All are characterized by restriction of motion; this may be slight, however, in the man who has performed heavy manual labor all of his life. In connection with this variety, the arthritic changes are often made worse by the injury. The majority of the cases are accompanied by backache or by somewhat severe pain. At times, pain is referred along the nerve roots. In advanced cases, the spine becomes rigid, precluding the usual motions; the back is held stiffly erect to prevent motion, or because of lack of mobility in others, the so-called "poker back" or a dorsal kyphosis develops, resulting in an habitual stooping posture. The head and neck are thrust forward, the gait and standing position are unsteady, attributable to the disturbance of weight-bearing and equilibrium, which the spinal changes have influenced. These are the typical cases of *spondylitis deformans*.

Both atrophic and hypertrophic arthritic changes occur. The former is indicated radiographically by increased intervertebral spaces and "lipping" of the bodies, due to atrophy and absorption of cartilaginous and osseous elements. The hypertrophic form is characterized by excessive and irregular bone production.

Chronic osteitis, or *chronic osteomyelitis*, results from low-grade infections which may or may not exhibit an acute stage. The course, symptoms and physical findings are similar to those of Pott's disease, with the exception that the infection is very likely to be confined to a single vertebra. Therefore, the angular kyphosis is not usually a gross one, as in advanced tuberculous disease, but rather, consists of a localized posterior knuckling. The radiographic appearance may show slight variations from the usual findings of Pott's disease. Repeated negative tuberculin reactions should make one suspicious of chronic infective osteomyelitis. The prognosis, in general, is more favorable than it is in tuberculosis.

Granulomata

Tuberculosis of the spine, commonly known as *Pott's disease*, is a disease of childhood, but may appear in infancy and adult life. It is frequently preceded by one of the acute infectious diseases, notably measles, scarlet fever and chickenpox, following which the child fails to make a normal recovery, particularly in regard

to strength, appetite and weight. Other factors, such as living conditions and personal hygiene, enter into its etiology, as they do in other types of tuberculous disease. Injury may precipitate its development. Pott's disease varies clinically according to the spinal region affected. The most common site is the dorsolumbar region; next in order of frequency, the lumbar region and lastly the cervical spine. An incipient stage, characterized by certain attitudes and by avoidance of various acts and sometimes by slight alterations in the spine, precedes the appearance of deformity. During this period, the child appears somewhat listless, loses the inclination to play in the usual fashion and becomes easily fatigued. Pott's disease, with few exceptions, is a chronic affection, and the reason for this introductory stage is apparent when one recalls that the initial focus is usually in the anterior surface of the body of the vertebra. Invasion of the vertebral substance is secondary to this, and vertebral collapse from the effect of superincumbent weight only takes place when the body of the vertebra has been severely damaged. The order of development of symptoms is also subject to variation. Abscess, ordinarily a complication of an advanced disease, may be the initial symptom; or pain, a very characteristic symptom and a fairly early one, may not occur until after deformity is recognized. There remains one factor which is of paramount importance in early diagnosis. This is *muscle spasm*. It is the first appreciable sign of vertebral tuberculosis, and it only vanishes when the disease has terminated. It explains the departures from normal in respect to attitude, position and actions. Objective determination of its presence is the very foundation of diagnosis in this affection. It also explains the occurrence of "night cries," a very suggestive symptom of tuberculous disease. Laboratory aids in diagnosis include roentgenology, and the von Pirquet reaction and the subcutaneous tuberculin test.

Let us first consider the *subjective history*, since this is the introduction to a given case. Some of the symptoms have been mentioned as indicating the incipient stage. These call for a thorough physical examination with especial detail in the investigation of the vertebral column. In addition, the child, if old enough, may complain of pain. This is not usually over the affected area, but is commonly of the referred or reflex type. Thus, the patient with high cervical tuberculosis complains of pain in the upper back and head. With low cervical or upper dorsal disease, pain is present in the shoulders, upper extremities or thorax. With dorsal Pott's disease, abdominal pain is most frequently alluded to as stomachache, often associated with vomiting and with localization of pain in the thigh, knees or other portions of the lower extremities. Or, with tuberculosis of the cervical spine, the parents may have observed that the head and neck are held stiffly and motion avoided, as in wry-neck; or the chin and head are dropped forward habitually; with low cervical and upper dorsal involvement, the head is retracted. When the dorsal region is involved, the child may have been noted to sit with the back arched, or to support himself against the side of the chair. In the lumbar affections, the observation may be to the effect that the abdomen is enlarging, or that the child seems to "push his stomach out"; that he avoids stooping motions; that he walks on his toes; or that he limps on one foot. Instead of, or in association with pain, there may be the history of night cries. These depend upon sudden motions of the invaded vertebrae during sleep, when the protective muscle spasm has receded. The child screams out suddenly because of pain. In some instances, the first symptom is a swelling in the lumbar

region or in the groin; or difficulty in swallowing and change of voice, when a retropharyngeal abscess has formed. In others, deformity is the first abnormality to appear.

Upon *examination*, abnormal attitudes are first looked for; change in position of the head; the apparent desire for external support in the dorsal region; flexion of one or both hips, with secondary lordosis and prominent abdomen when the lumbar region is affected. A simple test for rigidity of the spine is to have the patient pick up an object from the floor. In Pott's disease below the cervical region, he will squat down and recover the object rather than subject the spinal column to a stooping or bending motion. He then arises with the spine held stiffly erect. This test may be reversed by placing the child in a sitting posture and asking him to arise. In lumbar Pott's disease, the gait may be suggestive. The patient often walks on the front part of the feet, avoiding any jar on the heels which would be transmitted to the spine; or limps on one foot because of contraction of the psoas muscle. Bilateral psoas spasm sometimes causes a waddling or rolling gait, not unlike that of congenital hip dislocation (bilateral); and this impression may be fortified by the observation of lumbar lordosis and a protuberant abdomen. In the absence of deformity, diagnosis depends upon the determination of muscle spasm. This can be demonstrated by the usual technic of spinal examination in the upright dorsal and prone positions. In infants and children, corroboration can be obtained by supporting the body horizontally with the hands beneath the abdomen and chest. Incidentally, any test which satisfactorily demonstrates muscle spasm will also cause pain. Tenderness along the spinous process is sought. This often coincides with the site of disease.

In the dorsal region, Pott's disease is also accompanied by a cautious gait, restricted mobility and muscular spasm. In advanced cases, the stature is diminished, the head and neck appear to be sunken within the shoulder-girdle and the upper extremities appear longer than normal.

In the cervical region, muscle spasm is easily made out upon active and passive motion. Most striking are the attitudes of the head, which have been described.

The deformity of Pott's disease is characteristic. It consists of a kyphosis which is angular. That is, the backward curve exhibits a peak, with sloping contour above and below. This, of course, represents the stage of vertebral collapse. The earliest possible change in contour consists of a slight elevation in the normal curve of the back when the patient is examined with back arched to its fullest extent, the hands being placed on the floor. Later, one may note a single spinous process which projects farther backward than its neighbors, forming a "knuckle." The typical angular deformity follows this period.

The general condition is not significant, although underweight and impaired strength are commonly associated. The temperature reaction is also variable. Radiographic plates are of great value, but not always diagnostic. Any of the other granulomata may produce the same clinical and radiographic evidence. Pott's disease is, of course, the most common of the granulomata. The subcutaneous tuberculin test is reliable when positive. Low-grade infective osteitis can only be differentiated in this manner.

The chief complication of spinal tuberculosis is abscess. In the cervical region, this is retropharyngeal or suboccipital in location. In the dorsal region, the abscess

invades the posterior mediastinum, while abscess emanating from the dorsolumbar region usually extends along the psoas sheath, and often appears in the groin. Spinal cord symptoms, and even paralysis, may be associated with Pott's disease.

Syphilis.—Arthralgic pains in the vertebral region are common in the secondary and tertiary stages. Tertiary syphilis may cause gummatous infiltration of the vertebræ which results ultimately in the same clinical picture as is present in tuberculosis. The positive Wassermann reaction and response to treatment are diagnostic measures. There may be other syphilitic affections and repeated tuberculin tests will fail to give positive reactions. Although either hereditary or acquired syphilis may attack the spine, the usual age of incidence is greater than in the majority of tuberculous affections.

Changes in the vertebral joints similar to the Charcot joint of the extremities are rare. Tabetics commonly exhibit changes in alignment, particularly a dorsal kyphosis without angulation.

Actinomycosis and blastomycosis of the vertebræ are rare affections. The clinical appearance and course are similar to tuberculosis. There is, however, a tendency to extension to the surrounding tissues and infiltration of the skin with the production of sinuses. The discharged material may reveal diagnostic features when examined microscopically. Vertebral actinomycosis may be either a primary affection, or secondary to some other focus.

Typhoid Spine

Typhoid spine consists of a periostitis or osteitis which occurs during the course of typhoid fever, during the period of convalescence, or which may appear weeks or months after recovery from the acute disease. It is manifested by pain, tenderness and increasing restriction of motions of the spine. The lumbar and sacral regions are the sites of selection and slight injury often precipitates the condition. In rare instances, abscesses and kyphosis occur. The general tendency, however, is toward recovery. Diagnosis depends upon concurrent typhoid fever or the history of recent typhoid infection. Males are chiefly affected.

Gonorrheal Spondylitis

Gonorrheal spondylitis arises as a complication of urethral or pelvic infections. It is more common in the male. Pain in the spinal region, which is exaggerated by motion, is the first symptom. Tenderness soon appears and the back becomes progressively stiff. The prognosis is decidedly less favorable than in typhoid affections of the spine, although the symptomatology is similar. Advanced cases often result in an unyielding fixation of the spine, a true spondylitis deformans on the basis of gonococcal infection developing.

Curvatures

Curvatures of the spinal column may be either congenital or acquired. The curve may exist in a single region; may embrace two or more regions; or may extend throughout the movable spine. A curvature may be lateral, anterior or posterior to the normal vertical axis of the spinal column, and combinations of such

malalignments sometimes occur. In estimating curvatures, it is important to recall that one or two spinous processes may normally vary slightly from the line of those above or below. It is also essential to have the patient completely stripped of clothes, and to view not only the back but also the trunk, head, neck and extremities, both from the front and in right and left profile. A complete history and a complete physical examination are also required, since the etiology of these curvatures is rather complex, and alteration of position and function of other structures may be induced by spinal curvatures. It is also necessary to differentiate between curvatures of the spine which are symptomatic and those which are essential.

Lateral curvature, or *scoliosis*, may be either congenital or acquired. Most lateral curvatures are of the latter variety. Many are symptomatic, resulting secondarily to lumbar and sacro-iliac strains, shortening of one limb from any cause, poliomyelitis, rickets, osteomalacia and empyema operations. Others are developmental, attributable to deficient musculature and improper posture.

Many instances of lateral curvature or deviation are seen in association with sciatica, sacro-iliac injuries and diseases, and spinal injuries. Others result from habitual posture during work or school hours. Some are congenital, frequently due to malformation of one of the vertebral bodies. A neurologic disease, such as syringomyelia, pseudohypertrophic muscular dystrophy or infantile paralysis may be associated with scoliosis.

In considering the problem of lateral curvature, we must recognize that there is a rotation of the vertebral bodies in addition to the lateral deviation; that this element of rotation usually exceeds the external impression; and that this is a considerable factor in the concomitant deformities. In estimating the rotation, radiography is essential. We must also recognize that some curvatures are functional or postural and that others are organic or fixed. The essential difference between them lies in the fact that a postural scoliosis can be overcome by voluntary effort upon the part of the patient or the examiner. A neglected postural scoliosis will become a fixed one.

Most instances of scoliosis, when developmental at least, will be observed in childhood and adolescence, and in the female. Not to be lost sight of is the great influence of early rickets in its production. The essential factor, regardless of the underlying etiology, is a static one; namely, the effect of superincumbent weight and the effort to compensate for alterations in weight-bearing.

Scoliosis may affect the entire movable spine. This is known as total scoliosis, and is characterized by a general deviation of the spinous processes from the posterior median line of the body. Or it may affect any of the vertebral regions, cervical, dorsal or lumbar, or any two of these as cervicodorsal and dorsolumbar. By far the most common curvative is the dorsolumbar, in which the lumbar curve is primary and the dorsal curve secondary to it. In most cases, this causes an *S-curve*, with left lumbar and right dorsal convexity. This can be appreciated by the examination of the back in the erect posture, but will be more evident when the patient bends the trunk forward with the hands on the opposite shoulders. This maneuver will also bring out secondary structural changes in the thorax; thus the back of the chest on the side of spinal convexity will be higher when viewed in this position, if fixation has taken place. The thorax will be found correspondingly altered in shape and depth on the opposite side, with compression of the lungs, and,

perhaps, cardiac displacement in advanced cases. The loin opposite the lumbar convexity exhibits a sulcus; the wing of the ilium is prominent and on a higher level than its fellow; and the shoulder, usually on the side of dorsal convexity, is elevated. Thus, the prominent hip, loin, sulcus and elevated shoulder are usually on the same side.

Of general symptoms, the first are listlessness and a slouching attitude. Later, early fatigue, anemia, and back pain develop. In advanced cases, there are loss of weight, diminution in stature, general weakness, a peculiar gait with side swinging of the trunk and, perhaps, signs of cardiac and pulmonary embarrassment. It is important to realize that there is a developmental stage in lateral rotation, prior to the appearance of actual spinal deviation, and that this is characterized, in addition to the general symptoms, by the presence of a prominent hip, an elevated shoulder and a prominent scapula.

Lordosis is an exaggeration of the normal forward curve of the lumbar portion of the spinal column. It occasions persistent backache and a sense of weakness, and produces restriction of mobility of the trunk in the lumbar region. The pronounced forward bowing of the vertebræ is readily recognized by inspection of the patient from behind and in profile; and is easily corroborated by palpation. The first impression when viewing the patient with hollow back and protuberant abdomen is almost diagnostic. When put in the dorsal decubitus on a flat surface, the lordosis is also readily distinguishable.

Lordosis may occur in conjunction with other spinal deflections. It is usually a secondary condition, and is found particularly in affections of the hip joint, such as congenital and traumatic dislocations (recent and old); fractured hip united in poor position; tuberculosis and other hip-joint infections. The simplest and most frequent cases of lordosis are those associated with pendulous abdomens, pregnancy, and large intra-abdominal tumors. Lordosis is also indicative of certain neurologic affections, notably pseudohypertrophic muscular dystrophy and acute anterior poliomyelitis.

Kyphosis, or backward curvature of the vertebral column, may occur in any part of the movable spine, but affects principally the dorsal segments. It may be angular, with a backward projecting "hump" or merely a "knuckle" which is composed of one or more vertebræ. The most elementary form is a rounded, backward-curving upper dorsal spine, developing in childhood and adolescence, and causing "round shoulders." This is the result of improper posture, poor muscular development and failure to breathe deeply. A round-shouldered appearance, with a somewhat flattened chest, is the casual presenting feature. The vertebral alteration can often be corrected by muscular effort, and chest expansion. In advanced cases, however, the vertebral contour is not thus influenced, owing to muscular and ligamentary shortening.

A similar appearance is induced by prolonged occupation in a stooping position, the curvature usually involving both the dorsal and lumbar regions. Restricted motion is a constant accompaniment. Kyphosis also results from affections such as spondylitis or arthritis deformans, acromegaly, rickets and osteomalacia. A very striking kyphosis, which may be limited to a backward "knuckling" of only one spinous process, occurs in conjunction with other conditions which allow collapse of the vertebral bodies. Of these, tuberculosis of the spine, Pott's disease, is the

condition which results in the most severe deformities, although chronic infective osteitis or osteomyelitis is the causative factor in some cases; comparatively rare causes are vertebral actinomycosis, gumma and a new growth.

In Pott's disease, during the earliest stages of spinal deformity, a posterior jutting of a single spinous process may be observed, or two, three or more spinous processes may be posteriorly displaced from the normal vertical axis. With advanced vertebral collapse, an exaggerated angular deformity arises, with shortening of the trunk and the typical "hump-back" appearance.

Spondylolisthesis

Spondylolisthesis consists of a forward displacement of the lumbar spine upon the sacrum. Complaints of pain and weakness of the back result. Upon examination, one notes that the trunk is shorter than normal. The posture at first suggests an exaggerated lordosis, but inspection will reveal an abrupt hollow just above the sacrum, and a shortening of the loins, the lower ribs approaching closely the bony pelvis. The normal curve of the loins is altered, frequently with transverse groovings of the soft parts. Motions of the spinal column are restricted, especially forward and backward bending. The malposition can be palpated from the back and pelvic examination will reveal the fifth lumbar vertebra in advance of, and overlapping the sacrum. This condition arises from faulty development of the articulating structures, or may result from spinal injuries. It may be present at birth.

Malnutritional Diseases and So-called Dystrophies

Some of the diseases which affect the nutrition and growth of the osseous system are manifested in the spine. *Rickets*, for example, frequently causes spinal curvature, and undoubtedly is the basis for many curvatures which do not appear until late in childhood and adolescence. The distorted kyphotic spine of *osteomalacia*, in which the softened bones are twisted out of alignment by the superincumbent weight, has also been mentioned. Kyphosis also occurs quite constantly in *acromegaly*. Lordosis is seen in *chondrodystrophia fatalis*, and scoliosis is one of the diagnostic features of *syringomyelia*. The muscular dystrophies, also, may permit spinal deviations. The most notable in this group are the lateral curvatures associated with *pseudohypertrophic muscular dystrophy*. In addition, a fairly common variety of spinal curvature is that dependent upon the muscular paralysis of *anterior poliomyelitis*. Such curvatures may be induced by paralysis of either the paravertebral muscles, the anterior vertebral muscular group or the abdominal muscles. In *osteitis deformans*, the vertebræ are enlarged. Symptoms may or may not result.

Aneurysm

Aneurysm is actually of extraspinal origin. Because of its proximity to the vertebræ, however, aneurysm of the descending aorta, at times, causes progressive erosion of the vertebral bodies. This process is characterized by deep-seated pain in the back, sometimes referred along the dorsal nerves, and may easily be mistaken for a primary affection of the spine.

Hysteria and Neurosis

These functional disturbances occur quite frequently in relation to the spinal column. In hysteria there may be no factors other than temperament and the dramatic personality. In neurosis, some strain or direct injury often precedes the neurotic manifestations. The element of fear is usually prominent. In both conditions, restriction of motion is the most evident feature, while, subjectively, the patient complains of pain. The pain is commonly of bizarre type, not coinciding with the lesion apparently present nor with the nerve distribution of the area affected.

In hysteria, fixed attitudes of the spinal column, often with apparent deformity, are noted. With careful and repeated examinations, both the attitudes of hysteria and the restriction and fears of neurosis may be overcome. Trick movements and suggestion will play a large part in the elimination of organic disease, and will often demonstrate that motion is possible in a supposedly fixed spine. In some instances it may be necessary to perform passive motions under an anesthetic; for example, in hysterical torticollis simulating disease of the cervical spine. The general mental and physical characteristics of the individual, together with other hysterical and neurotic manifestations, must be looked for and considered. The radiograph, of course, is of value in elimination. Malingering is of very common occurrence in association with back injuries.

Tumors

Primary tumors of the vertebræ are not common. Sarcoma may occur in children or early adults. Back pain is the earliest symptom. This is followed by restricted mobility and, later, by deformity. Invasion is rapid, and the spinal cord is soon involved, with resulting irritative symptoms, and finally paralysis. Emaciation and the usual sequels of malignant affections develop. The x-ray is the most valuable means of early diagnosis.

Secondary tumors are more frequent, and include both sarcoma and carcinoma. Of the two, the latter is more often found, since the spine is a favorite site of metastasis from primary tumors of the breast, thyroid, prostate, and uterus. This is especially true of breast malignancies. A secondary carcinoma may exist in the vertebral body for some time before the development of symptoms, and may be present at the time of operation for what is regarded as a localized tumor of the breast.

Or, metastasis may appear months or years after a radical operation. The symptoms consist chiefly of pain and disability. The pain may be localized in the back or referred along the nerve trunks to lower levels. Paralysis is a sequel, due to involvement of the spinal cord; and deformity may result from bone destruction and vertebral collapse.

Secondary sarcomata usually occur by extension, as from a primary retroperitoneal sarcoma. The symptoms are similar, though, as a rule, more rapid in their course than those of carcinoma.

For myeloma see Differential Chart, "Tumors,"

AFFECTIONS OF THE JOINTS

Congenital deformities { congenital dislocations
locked jaw
absence of joint
ankylosis

Injuries { wounds
dislocations and joint fractures
loose bodies
subluxated cartilage
ligament tears
traumatic synovitis
traumatic arthritis
hemorrhage

Loose bodies

Subluxated cartilage

Dislocations { congenital
traumatic
arthritic
paralytic

Arthralgia

Synovitis and arthritis { primary acute arthritis { acute articular rheumatism { adults
children
acute gout
acute traumatic arthritis
secondary acute arthritis { due to specific organisms or diseases of known etiology { ordinary pyogens
acute arthritis of infants
pneumococcic arthritis
typhoidal arthritis
gonorrheal arthritis
syphilitic arthritis
influenzal arthritis
meningococcal arthritis
complicating diseases of unknown or doubtful etiology { scarlet fever
measles
rubella
dengue fever
Malta fever
smallpox
acute myelitis
Raynaud's disease
chorea
purpura
anaphylaxis
purpura rheumatica or Schönlein's disease

Synovitis and arthritis (<i>cont.</i>)	{	chronic arthritis	tuberculosis
			syphilis { secondary stage tertiary stage congenital tabetic
			chronic gout
			chronic gonorrheal arthritis
			arthritis deformans { hypertrophic atrophic Still's disease
			intermittent hydrops
			chronic serous synovitis
			villous arthritis
			hemarthrosis
			neuropathic arthritis { Charcot's joint syringomyelia poliomyelitis and oth- ers
			hypertrophic pulmonary osteo-arthropathy

Lipoma arborescens

Baker's cysts

Tumors of joints	{	chondroma
		osteoma
		lipoma
		sarcoma

Contractures due to hysteria

History

Age; Sex; Occupation

Family History.—Tuberculosis, cancer and other tumors, syphilis, rheumatism, gout, heart and kidney diseases, nervous affections.

Personal History.—Acute infectious diseases, venereal history, tuberculosis, rheumatism, gout; type and number of attacks; heart trouble, tonsillitis, nervous affections. Previous attacks similar to present illness. Injury.

Present Illness.—Date of onset and character. Has affection any relation with previous venereal disease, acute infection or injury? Single or multiple affection. Time of involvement of different joints. Exacerbations and relapses. Chills and fever. Pain: character and radiation. Is it increased at night? Night-sweats and cries. Loss of weight. Cough. History of joint locking. Previous or present treatment for a heart affection.

Physical Examination.—Joint involved; its size, contour, signs of effusion within or about the joint, crepitus or "grinding," thickening, alterations in bony outline, signs of inflammation or sinus, discoloration of skin, measurements as compared with its fellow of opposite side. Tenderness on pressure and pain on manipulation. Muscular wasting. Degree of limitation of motion. Locking on movement of joints. Complete examination of heart and lungs. Signs of syphilis

or tuberculosis in other parts of body. Subcutaneous nodules. Temperature. Radiographic examination. Tuberculin and Wassermann tests. Leukocytes. Examination of regional lymph glands. Arches. Pupillary and Romberg. Presence of petechiæ in any part of the body. Signs of spinal cord lesion. Blood culture if necessary. Guinea-pig inoculations.

INTERPRETATION OF HISTORY

Age

<i>Infancy</i>	{	congenital malformations
		acute arthritis of infants (pyemic)
		Still's disease
		scurvy
		hemophilia
<i>Childhood</i>	{	arthropathies of poliomyelitis
		arthropathies of hereditary syphilis
		acute articular rheumatism
		tuberculous arthritis
		syphilitic arthritis
		Perthes' disease
		various forms of secondary arthritis
<i>Early and Adult Life</i>	{	hemarthrosis
		Still's disease
		injuries
		same as above
		injuries
		gonorrheal arthritis
		chronic serous synovitis
		intermittent hydrops
		benign tumors
		neuropathic arthropathies
		arthralgia
<i>Advanced Age</i>	{	subluxated cartilage
		loose bodies
		sarcoma
		gout
		injuries
		arthritis deformans
		gout

Sex.—Males, being more exposed to trauma, more frequently suffer joint injuries than females. Gout occurs mostly in men. The preponderance of females affected with arthritis deformans, spondylolisthesis and Charcot's joint is noteworthy.

Occupation.—Has little significance, excepting that villous arthritis and intermittent hydrops often depend upon some disturbance of weight-bearing, and are likely to occur in workers who maintain an upright posture.

Family History.—Hereditary syphilis may involve the joints. History of family tuberculosis, cancer, rheumatism and nervous affections suggests the predisposition of the patient to similar diseases, while in gout the tracing of a "diathesis" is of interest. Acute articular rheumatism is considered to be of a possible hereditary nature.

Personal History.—The *acute infectious diseases* precede many instances of acute arthritis and synovitis, while tuberculous arthritis is prone to develop in their wake.

Venereal history, when positive, intimates the possibility, or fortifies the probability of gonorrheal or syphilitic affections of the joints, including Charcot's joint.

Tuberculosis.—Patients with tuberculous foci are obviously prone to joint tuberculosis.

Rheumatism.—The history of "rheumatism" should not be loosely interpreted. It may mean any sort of joint condition, and is to be valued by careful investigation of former attacks of the disease.

Gout.—When there is a definite history of gout, involvement of larger joints should be regarded as being of the same origin, in all probability.

Heart trouble occurring during an acute arthritis aids in the diagnosis of acute articular rheumatism.

Locomotor Ataxia.—Charcot's joint occurs in this affection, particularly in females.

Tonsillitis predisposes to, and often immediately precedes, acute rheumatic fever, and many of the so-called "infectious" types of arthritis deformans.

Previous Attacks.—The following affections have a marked tendency toward recurrence; namely, acute articular rheumatism, loose bodies, subluxated cartilages, dislocations, arthralgia, acute and chronic gout, gonorrheal arthritis and tabetic arthritis, chronic gonorrheal arthritis, intermittent hydrops, chronic serous synovitis, hemarthrosis, and, occasionally, cysts and tumors.

Injury produces all the conditions classified under "Injuries." It also precedes many cases of secondary arthritis, tuberculous arthritis, Charcot's joint and Perthes' disease.

Present Illness.—The date and character of the onset are of great importance, as is also the relation between the present illness and venereal disease, acute infection or injury.

Single or Multiple Affection.—Pyogenic arthritis is commonly monarticular. Gonorrheal arthritis is often monarticular, but probably 40 per cent are polyarticular. Acute rheumatic fever is polyarticular, as is arthritis deformans. Gout is usually monarticular (great toe) at the onset.

Time between Involvement of Joints.—In acute rheumatic fever the joints are involved successively, the local signs appearing in one joint as they recede in the other. The acute arthritis of infants, when polyarticular, affects the various joints simultaneously. In arthritis deformans the joints are usually involved successively, particularly following acute exacerbations. This is also true of gout.

Chills and Fever.—In acute articular rheumatism, acute secondary arthritis, pyogenic and tuberculous arthritis with pulmonary lesions and Still's disease, chills and fever are usually present.

Pain is an accompaniment, at some time or other, of most joint affections. It is often agonizing in acute rheumatic fever, gout, purulent arthritis and subluxated cartilage. Its absence in neuropathic arthritis, particularly Charcot's joint, contrasting with the radical pathologic alterations, is a strong point in diagnosis. Hemarthrosis is often painless, while this feature is exceedingly variable in arthritis deformans. The pain of tuberculous arthritis is often at its maximum at night, and is accompanied by night-cries, due to sudden muscular spasm after

their involuntary relaxation during sleep. In arthralgia, pain is the only symptom, and may be severe or of an inferior grade. In hysteria the pain complained of is extreme, but the objective signs do not coincide with the patient's story. Pain of gouty arthritis is often severe.

Joint Locking.—This history may be obtained in the presence of a subluxated cartilage and loose bodies.

Physical Examination.—*Joint Involved.*—The joint or joints involved in a given process have some bearing on the nature of the disease, and influence the diagnosis in many instances. Isolated arthritis of the metatarsophalangeal joint is characteristic of gout. Acute articular rheumatism involves the larger joints, or the smaller joints in connection with the larger. Gonorrhea has a tendency to affect the sternoclavicular, sacro-iliac, intervertebral and temporomaxillary articulations. Arthritis deformans affects smaller and less prominent joints, such as the interphalangeals.

Congenital Deformities

Congenital deformities of joints are unusual. The most important is congenital dislocation, particularly of the hip joint. Similar affections of the knee, patella and shoulder do arise, but they are much less frequent.

Congenital Dislocations.—In the *hip joint*, dislocation is either uni- or bilateral. It is more common in girls, and usually is not evident until the child begins to walk. Then, if unilateral, there is a decided limping on the affected side; or the limb may appear to become suddenly shorter as the child puts its weight on that side. If bilateral, the gait is of a waddling or rolling character. Examination discloses certain features. In the upright position there is lumbar lordosis and scoliosis toward the affected side, the former sign being more marked in the bilateral affection. When standing on the involved limb, in unilateral dislocation, the buttock of the opposite side drops downward so that the corresponding gluteofemoral fold is lower than of the affected side. This constitutes *Trendelenburg's sign*.

In the prone position there are both visible and measured shortening on the affected side. The greater trochanter of the femur is raised above Nélaton's line, and the head of the bone, if the dislocation is complete, is palpated on the dorsum ilii above the acetabulum. The trochanter can be lowered and the shortening decreased by traction on the limb. In bilateral dislocation, the perineum is unusually wide. The clinical diagnosis can be made in most cases by the symptom-complex of a painless limping or waddling gait in an infant or young child; lumbar lordosis; and shortening of the affected limb, together with upward displacement of the greater trochanter and head of the femur. Instead of limitation of movements, as in inflammatory conditions and such deformities as coxa vara, abnormal mobility exists in congenital dislocation, excepting the movement of abduction which is somewhat restricted. Radiography, of course, is important.

Congenital dislocation of the *patella* is usually outward. In the *knee joint*, dislocation may be complete or incomplete. In the former the tibia is displaced backward, while the condyles of the femur look downward and forward. The incomplete form may show either hyperextension or genu recurvatum.

Congenital dislocation of the *shoulder*, a rare occurrence, is of the subspinous variety, the head of the bone being unduly prominent posteriorly, while there is a

corresponding depression in front. The pseudoparalysis arising from loss of function of the shoulder simulates obstetric palsy. The attitude in congenital dislocation is entirely different and easily differentiates the two, for the elbow is raised upward and forward and the forearm and hand are partially flexed and thrown across the front of the thorax. Contrasting with this deformity, in Erb's birth-palsy, the arm and forearm hang limply at the side, with the wrist pronated and the palm facing backward.

Locked jaw is another unusual congenital deformity, the child being unable to move its lower jaw. This is due to an abnormal enlargement of the coronoid process.

Congenital absence of an articulation is so unusual that discussion is not merited.

Congenital ankylosis has also been reported, but is extremely rare.

Injuries

The articulations are exposed to both direct and indirect injuries.

Penetrating Wounds.—Proof of joint penetration is given by the escape of synovial fluid from the external wound. Infection is very likely to follow.

Dislocations and joint fractures are frequent, and usually complicated by effusion into the joints. See chapter on "Fractures and Dislocations."

Loose Bodies.—Fragments of bone or cartilage often become detached and are free within the joint. They restrict motion, or produce definite locking of the joint, and excite joint effusions.

Subluxated Cartilage.—Likewise, a joint cartilage may become dislocated or subluxated by an injury. The symptoms are either apparent at once or not until the period of convalescence from the original trauma.

Ligamentary tears are produced frequently in conjunction with joint injuries. They may be found upon physical or radiographic examination.

Synovitis.—A common result of a joint injury is the development of a synovitis or inflammation of the synovial membrane. It is characterized by a rapid swelling of the joint, with distention of the periarticular depressions. This swelling is fluctuant in character. The overlying skin may be warm. Unless there has been a penetrating wound, infection is unusual. The range of mobility of the joint is restricted according to the amount of fluid present. Instead of being limited to the synovial membrane, the various neighboring structures may be affected, a true arthritis arising.

Hemorrhage into a joint frequently follows injury. There is a rapid enlargement of the joint with decreased function and signs of fluid. This fluid may be suspected of being bloody in all cases of joint fracture and penetrating wounds; in many dislocations; and in many injuries, caused by indirect violence, when extensive ecchymosis is present. Aspiration demonstrates the character of the fluid, but it is not performed, as a rule.

Loose Bodies

Loose bodies are found in the knee joint especially. Foreign bodies introduced from without may remain within the joint. Cartilages or bony spicules are often

broken off by injury, while "rice-bodies" or "joint-mice" develop as a result of a pathologic process. Thus, both the size and number vary. Loose bodies often exist without any symptoms. In others, a synovitis occurs or recurs. This has the usual characteristics and may be entirely painless. What should always direct the attention to the possibility of a loose body is sudden locking of the joint. This occurrence is very painful and is often followed by a rapid effusion into the joint. A loose body can rarely be palpated. Radiographs demonstrate varieties, such as shell fragments, bullets, needles and calcareous particles, but fail to show many others.

Subluxation of Cartilages

This affection is seen practically only in the knee joint, where the internal cartilage is more often partially dislocated than is the external one. Subluxation is caused by trauma in most instances, but usually does not produce symptoms until some time after the original injury. Then, following further slight injury or twisting, the knee becomes suddenly fixed in partial flexion, and there is excruciating pain. The patient may be unable to move the limb, but passively, flexion can be increased. Extension, however, is absolutely inhibited, and any attempt at manipulation is painful. In some subluxations, the cartilage is palpable, and the patient occasionally is able to overcome the pain and flexion deformity, and regain the use of his limb by digital pressure upon it. An effusion often ensues with great rapidity after a subluxation, masking the underlying condition. The condition is to be suspected in all cases giving a history of recurrent synovitis or joint locking.

Dislocations

Dislocations arise from traumatic, arthritic, neuropathic and congenital causes. Only a few of the more uncommon ones will be considered here.

Spondylolisthesis consists of a dislocation of the fifth lumbar vertebra upon the sacrum, or the fourth upon the fifth lumbar, the body of the particular vertebra being displaced downward and forward to a greater or lesser degree. Females are chiefly affected. Trauma precedes some cases. The patient appears dwarfed, there is a visible depression above the sacrum, with lumbar lordosis, and flattened buttock, these features contributing to a "saddle-back" appearance. The pelvic inclination is diminished, while the lumbosacral angularity is evident upon pelvic examination. In the standing posture there is flexion at the hips, knees and ankles. Neuritic symptoms and weakness of the legs and back are complained of.

Madelung's deformity of the wrist is a condition which gradually develops in late childhood and adolescence. Slight trauma precedes some cases. It is best described as a subluxation of the wrist joint, the lower end of the ulna being displaced backward, while the radius may be curved forward. The only subjective symptom is awkwardness. Extension is interfered with, and pronation and supination are also often restricted. Girls are more apt to be afflicted with this affection.

Arthralgia

Neuralgic pains in, or about, the articulations occur in neurotic individuals without apparent cause, and constitute one of the prominent symptoms of hysterical

affections, as well. Arthralgia also occurs in secondary syphilis without demonstrable joint pathology, and in peripheral neuritis. Arthralgia of the knee joint may be so severe in hip disease as to distract the attention from the actual seat of disease. In the lower extremity, pains about the knee and hip are often produced by disturbances of weight-bearing, and always bring to mind the possibility of weak feet. Lead poisoning and often forms of peripheral neuritis also cause arthralgia.

Synovitis and Arthritis

Clinically, it is often impossible to differentiate synovitis and arthritis, although a definite pathologic classification distinguishes the two. The former consists of an inflammatory process of the synovial membrane alone, while in true arthritis, the joint cartilages and ligaments and neighboring tendinous and bony structures may be involved. As being more indicative of the character of the majority of joint conditions, the term arthritis will be used here to include both the minor and major affections. To aid proper diagnosis, arthritis is best divided into the acute and chronic forms, remembering that occasionally a chronic disease starts with acute symptoms. Under such conditions, differentiation may be made by the character of the joints involved, the general and local symptoms and the course of the disease. The diagnosis of joint affections is built upon family and personal history and careful local and physical examinations, reinforced in many cases by certain laboratory data. Every available item of information along any of these lines of inquiry is important. Joints are often aspirated and valuable facts gained from the physical and bacteriologic properties of the material obtained. The etiology is often obscure. Variations in symptomatology require that many affections, in no way of a surgical nature, be considered.

ACUTE ARTHRITIS

Primary acute arthritis includes articular rheumatism or rheumatic fever, acute forms of gout and acute traumatic arthritis.

Acute articular rheumatism is most often seen in young adults, frequently in children. In infancy it is a rarity. In the adult form, which is also the type often seen about the tenth year of life, the onset is acute, with high fever, increased pulse rate, often chilly sensations, and pain in a single joint, usually a large one. The joint rapidly swells, the skin becomes red, hot and tender. The slightest motion causes severe pain and the patient has profuse acid sweats. As the process subsides in one joint, another is involved, succession being the rule rather than simultaneous multiple arthritis. There is a strong tendency to endocarditis and pericarditis, a cardiac murmur frequently being heard. Leukocytosis of 12,000 to 15,000 is present. Smaller joints such as the intervertebral, sternoclavicular and temporomaxillary, which are particularly prone to gonorrheal infections, are usually free in acute rheumatic fever. Tonsillitis precedes many cases of this disease. The joint fluid is serous and sterile. Many times gout cannot be differentiated, since gouty articular rheumatism may attack the joints. The personal history, the presence of tophi, general physical findings and the chemistry of the urine and blood are diagnostic points to be investigated.

Acute rheumatic fever in childhood is essentially different from the adult form. It is rare before the fifth year and almost unknown in infancy. In contradistinction to the adult type, the onset is subacute, the temperature is usually low, and the local signs are moderate. In fact, many children complain of but slight pain and are not confined to bed; whereas the adult with articular rheumatism is a pain-ridden, physically helpless individual. Often, too, instead of being a polyarticular affection there is but one joint affected, especially the hip, knee or ankle, which is painful, tender and somewhat swollen. The joint lesions are usually entirely overshadowed by the signs and symptoms of cardiac disease. Ambulatory cases of low grade, with lameness and muscular spasm, thus resemble tuberculous arthritis very strongly. In childhood, the association of tonsillitis, endocarditis, pericarditis and chorea is much more frequent than in the adult, and the recognition of one of these conditions in conjunction with articular disease makes a correct diagnosis possible in puzzling cases.

In both adults and children, there may be subcutaneous nodules within various tendons, and frequently purpura and erythema are present. Secondary anemia develops with great rapidity in both.

Gout is a metabolic disease associated with arthritis. It is rare before thirty and occurs mostly in males who are subject to dyspepsia and have high blood-pressure with its train of symptoms. There is a marked familial history. The disease may be acute, chronic or atypical.

Acute gout comes on suddenly, usually at night, with great pain in the first metatarsophalangeal joint, which then becomes swollen, extremely tender and reddened. Fever, often of 103° , and leukocytosis are usually present. Premonitory symptoms, as irritability and flitting pains, may occur. The attack in a typical case lasts one to two weeks, with exacerbations of pain at night, and then gradual subsidence. The urine is scanty, contains albumin and casts, and the uric acid output is increased after the onset. In such cases the diagnosis is not difficult. A polyarthritis, however, may be present in acute gout, involving particularly, in addition to the first joint of one or both great toes, the ankles, knees and small joints of the hands, and simulates acute rheumatic fever. The presence of tophi—uric acid deposits—on the ears or fingers may constitute the only differential point. In their absence, the age of the patient, the family history, the habits of living and the signs of hypertension are suggestive, while a history of former acute arthritis of the great toe is almost conclusive.

Chronic gout results from repeated acute attacks, and is characterized by permanent enlargements of the smaller joints of the feet and fingers, sometimes the ankles, knees and other joints as well. Tophi are deposited about the affected joints and in the ears, and are diagnostic. Acute exacerbations recur at irregular intervals, the patient meanwhile feeling fairly well, or being subject to various other disorders. Chronic gout must be differentiated from arthritis deformans. In addition to the points mentioned previously, the chemistry of the urine and blood is a valuable aid in doubtful cases.

Atypical or irregular forms of gout occur in individuals who have the gouty tendency or diathesis, but in whom the arthritic changes are subordinated to a host of disturbances. These include various cardiorenal, nervous and gastro-intestinal symptoms.

The clinical picture of *acute traumatic arthritis* has already been described under injuries, and consists of a painful swelling of the joint, with signs of intra-articular fluid, and impaired function. Fever, if present, is low. Unless there is a penetrating wound, infection is very rare. High fever after a trauma to a joint should therefore suggest the presence of some focus of infection elsewhere. Suppuration within a joint is indicated further by increase of the local signs, the skin becoming infiltrated and brawny or edematous, very tender and painful, and the regional lymph-nodes often enlarging. There is leukocytosis. Aspirated fluid after trauma is either serous or serosanguineous. In the event of infection it is seropurulent or purulent. The lighting up, or determination of a gonorrheal, tuberculous or luetic arthritis by trauma must not be forgotten.

Chronic serous synovitis is an occasional sequel of traumatic arthritis and some degree of impaired function may also result.

Acute Secondary Arthritis.—Of this there are many varieties, according to the etiologic factor. Acute suppurative arthritis should always be considered as a secondary process, and search made for an infective focus in the vicinity or elsewhere in the body. Such a local point of entrance for organisms may be of minor nature. Thus, a furuncle may be responsible for an arthritis, although this is exceptional. Inflammatory processes in the skin, soft tissues or bone may infect a joint by continuity; while pneumonia, typhoid and scarlet fevers, measles, pyemia, influenza, gonorrhea, syphilis and (very rarely) tuberculosis are frequent general causes. Many of these will be considered subsequently.

In *acute pyogenic arthritis* the affected joint and surrounding tissues are swollen, the overlying skin is reddened, often edematous or brawny, the entire joint being held in a fixed position. This position is often one of slight or exaggerated flexion, since this gives the most comfort. A touch or movement produces pain. The pulse and temperature are elevated and there may be marked prostration. Rigors sometimes occur. The regional lymph-nodes are often enlarged and tender. The temperature, in some cases, is of the septic type; in others, it is maintained. One or more joints may be involved. A focus somewhere in the body may or may not be demonstrated. Fluid aspirated from the joint cavity is seropurulent or definitely purulent and contains pyogenic organisms. Extensive destruction of the joint structures may follow as may also pyemia. Blood cultures, taken during the height of the condition, often show the presence of streptococci or staphylococci.

The *acute arthritis of infants* is a manifestation of pyemia, occurring in the first year of life, especially during the first six months, and may even occur in the newborn. It is not strictly a pyogenic arthritis, as the gonococcus and influenza bacillus may be the causative agents. Organisms are found in blood cultures and aspirated material. The clinical picture is one of acute onset with high fever, pain and tenderness of one or several joints, immediately followed by swelling of the joint and involvement of the periarticular tissues. Fluctuation or brawniness is found on palpation. The infant is acutely ill, refuses to nurse, is restless, and soon shows evidences of general prostration. If multiple arthritis occurs, the joints are affected simultaneously. It will be recalled that acute rheumatic fever at this age is a rarity, and is therefore readily differentiated. The umbilical cord should be regarded as a possible portal of entry in young infants. The most im-

portant differentiation is from scurvy. The history of dietary error and the presence of subcutaneous hemorrhages, tender epiphyses, and swollen, bleeding gums, are the predominant features of the latter disease.

Pneumococcic arthritis usually involves only a single, large joint, the knee joint being the most susceptible one. The onset is acute during the course of or after pneumonia, with signs of a synovitis or arthritis. Infrequently, a pneumococcic arthritis precedes the pulmonary process. Regardless of the relation between the two, this type of arthritis is always severe, and is, in reality, a local manifestation of pyemia. Accordingly, many cases are fatal and ankylosis is to be expected in those fortunate enough to recover. Blood cultures and aspiration of the joint usually yield the pneumococcus, the fluid being definitely purulent, or, very rarely, serous.

Typhoidal arthritis is an uncommon complication or sequel of typhoid fever and may appear weeks or months after the acute illness. When monarticular, which is the rule, it affects particularly the hips and other large joints. As a result of rapid effusion and exudation, a spontaneous dislocation is not infrequent. The joint fluid is serous or purulent. Cultures may show no organisms whatever; a *B. typhosus*, or a mixed infection, may be found.

The arthritic complications of *cerebrospinal fever* are the outstanding features of some epidemics. Polyarthritis is usually present, many joints becoming swollen, painful and tender simultaneously. The exudate is either serous or purulent.

Secondary arthritis complicating the acute infectious diseases, or occurring during convalescence therefrom, may show either a serous or purulent exudate. Thus, scarlet fever has a tendency to attack the smaller joints, the wrist, hand, elbow and knee in order of frequency, the pathology being that of a serous synovitis. At times, however, a most severe suppurative arthritis, the result of a streptococcus monarticular or polyarticular infection, may arise. In dengue fever, the successive involvement of large and small joints with enlargement, pain and tenderness and superficial hyperemia suggests rheumatic fever. The general phenomena will differentiate between them.

Purpura rheumatica (*Schönlein's disease*) is characterized by a multiple arthritis, purpuric rash and urticaria or erythemia. Arthralgia is the most prominent symptom. The acute onset with fever, and often with sore-throat, suggests rheumatic fever. The cutaneous manifestations establish the identity of the disease, although the association of purpura with acute articular rheumatism must not be forgotten. Arthritic symptoms may also present in conjunction with Henoch's purpura.

CHRONIC ARTHRITIS

Tuberculosis.—Joint tuberculosis occurs especially in children, but is also common in early adult life. As in other types of tuberculosis, the patient is often poorly nourished; there is often a family history of the disease; and other manifestations may present. Any joint may be attacked. There are both *serous* and *fibrous* forms, so that a given case may be characterized either by effusion into the joint, or by changes in the joint structures and periarticular thickening. Complications, notably abscess, sinus formation, dissemination and amyloid disease,

attend tuberculous joints as they do in other forms of the disease. The rôle of the acute infectious diseases is important, and the history of such, preceding the onset of joint symptoms in a child, is very suggestive. Trauma also is responsible for the excitation of tuberculous foci, and may be a factor in the determination of the site of disease. Tuberculosis of the hip and knee joints is so striking and important that these conditions will be considered more in detail.

In order of frequency, *tuberculosis of the hip*, commonly known as "hip disease," stands first. It occurs chiefly within the first ten years of life, particularly after the second year, and is a chronic progressive process. Lameness or moderate stiffness of the joint is the first symptom, following which there is pain in the hip, often radiating down the thigh. Pain may be referred entirely to the knee. A limping gait develops. Often a long step alternates with a short one. Frequently, the history of night-cries is given. The disability gradually increases, causing marked pain and deformity.

Objectively, the buttock becomes widened transversely, and the trochanter is prominent. If there is fluid in the joint, a visible swelling presents posterior to the trochanter. The thigh muscles become atrophied. Alterations in the gluteal folds—obliteration of one or both on the affected side—take place. Upon testing the joint function, limitation of motion is encountered, particularly in extension, abduction and rotation, this restriction being palpably dependent upon spasm of the adjacent muscles. Along with these signs, there is an attitude of deformity which varies with the stage of the disease. In the first stage, this consists of abduction, outward rotation and slight flexion of the limb, with apparent lengthening, the latter being the result of downward tipping of the pelvis on the affected side. In an advanced state, there are abduction, inversion and flexion with consequent apparent and, sometimes, measured shortening of the limb. With absorption of the head of the femur or the acetabulum there is actual shortening, and the trochanter is above Nélaton's line. Lordosis accompanies the deformity. This can be overcome by flexing the sound thigh upon the pelvis, this test also serving to illustrate the muscle spasm of the diseased side. Radiographs are very important. The subcutaneous tuberculin test furnishes valuable data. Loss of weight and strength occur in conjunction with hip disease. Inguinal adenitis is common.

Differential Diagnosis.—Hip disease must be differentiated from many other affections and radiography may be the only satisfactory means. This is especially true in (a) Perthes' disease which will sometimes present the same signs as early hip disease. (b) Coxa vara is characterized by limp, shortening of the limb, elevation of the trochanter and limitation of abduction and rotation. It is not painful. Pathologic coxa vara occasionally results from tuberculous coxitis. (c) Knee joint disease is excluded by the absence of physical signs referable to that region. (d) Congenital dislocation of the hip dates from the first attempts at walking. There is no fever or loss of weight and no muscle spasm. (e) Atrophic arthritis occurs in childhood and is distinguished by its progression, other joints becoming involved.

Tuberculosis of the knee joint is likewise most prevalent in children and young adults. The onset is not abrupt. The earliest symptom is slight stiffness of the knee which may be somewhat tender. In walking, the child is apt to be

a little lame, but all of these symptoms are inconstant. Later, the stiffness is permanent; there is local pain, and the knee begins to enlarge. This enlargement is of bony origin, or occasionally due to synovial effusion; soon, however, chronic inflammatory thickening characterizes the disease and the region of the knee presents a fusiform, firm swelling which is emphasized by muscular atrophy above and below the joint. The skin is pale and glossy, from which fact the swelling earns its name of "tumor albus." The knee joint is held in partial flexion, the hamstring muscles being in a state of spasm. Passive motion is, of course, limited and painful. In advanced stages outward rotation of the tibia, genu recurvatum or genu valgum may be present, and extensive destruction and absorption may produce actual shortening of the limb. Radiography and the tuberculin test are important accessory diagnostic agents. Abscess and sinus formation may occur. As with hip disease, the history of a slowly progressing affection, plus night-cries, muscular spasm, constitutional disturbance and deformity, furnishes a rather characteristic syndrome.

Tuberculosis of the ankle is a chronic disease most commonly noted in children. It is characterized by swelling, which is usually on the anterior aspect; pain and tenderness, muscular spasm and atrophy; and deformity. In the early stages there is dorsal flexion, but in the later stages, plantar flexion with equinovalgus. Radiographs show typical lesions. Sinus formation is relatively late and may be multiple.

Tuberculosis of the elbow ranks fourth among the joints in the order of frequency of involvement. The swelling is fusiform, with marked muscular atrophy above it, and little or none in the forearm. Pain is present in the joint and often radiates downward. When the deformity is typical, the forearm is midway in flexion and is in midpronation. In early cases there is simply a moderate limitation of motion at the articulation. Muscle spasm is evidenced upon passive motion. One or more sinuses are very likely to result.

Syphilis.—Arthralgia is common early in the secondary stage. Infrequently, an acute or chronic synovitis develops. In the acute form a single joint swells rapidly and is tender and painful. Inflammatory signs in the skin are lacking, the condition is not polyarticular, and fever, if present at all, is not high. The past history and detection of other secondary symptoms aid in diagnosis, as does the Wassermann reaction. Chronic syphilitic serous synovitis follows the above or develops gradually, finally presenting in either instance as an hydrarthrosis. Both forms occur with greatest frequency in the knee joint. A gummatous synovitis or arthritis occurs in tertiary syphilis. Found mostly in the knee joint, it resembles, both in its course and clinical appearance, the "tumor albus" of tuberculous arthritis. Other signs of the disease, the Wassermann and tuberculin reactions with radiography must be relied upon.

Tabes is sometimes accompanied by a neuropathic disease of a joint, characterized either by hypertrophic or atrophic alterations. The typical condition is known as Charcot's joint.

In hereditary syphilis, effusion into a joint occurs in cases of epiphysitis and osteitis, as well as in primary gummatous infiltration of the synovial membrane. Quite significant is the sudden development of a painless bilateral synovitis of the knee joints in a child.

Gonorrheal Diseases of Joints.—These affections are more common in the male and occur during the acute stage or in the course of chronic gonorrhea. One or more joints may be involved, and acute and chronic forms are seen. While any articulation may be attacked, there is a tendency for the infection to involve articulations which are ordinarily exempt in acute rheumatic fever, such as the sternoclavicular, sacro-iliac and temporomaxillary joints. The knee and ankle joints are, however, commonly involved. In the acute variety the onset is sudden with rise of temperature, malaise and swelling of one joint, most often the knee or ankle, which appears reddened, hot and tender. Signs of intra-articular fluid can usually be obtained. Coincidentally, the urethral discharge ceases, or may become aggravated. In many cases, it is impossible to detect any focal gonorrhea, especially in women. A positive gonococcus fixation test is suggestive but not necessarily conclusive. Massage of the prostate and vesicles sometimes causes shreds and pus to appear in the urine. The arthritis may be confined to a single joint or may attack other joints in succession. The fluid is serous, seropurulent, serofibrinous, exceptionally purulent, and the local signs are exaggerated in the latter instance. Gonococci are seldom found in the aspirated material. The course is from two to four weeks. A chronic arthritis may ensue.

Chronic arthritis of a gonorrheal origin follows the acute process or is primarily chronic. Widespread destruction during an acute or subacute gonorrheal arthritis leaves in its wake a chronically inflamed and impaired joint, and may produce ankylosis. Milder grades of infection cause a chronic serous synovitis which can only be distinguished from other types of this affection by the presence of a local gonococcic process.

Arthritis Deformans.—Arthritis deformans is a chronic disease of unknown etiology. It is variously known as rheumatoid arthritis, osteo-arthritis and arthritis sicca. The most satisfactory division of the disease appears to be into (a) hypertrophic arthritis, (b) atrophic arthritis and (c) Still's disease. Although essentially chronic, as has been stated, arthritis deformans often consists of a series of acute attacks with the gradual production of chronic joint changes. Or, acute exacerbations occur in the course of chronic polyarthritis.

(a) *Hypertrophic arthritis* makes its appearance in middle and old age and is common in women about the menopause. When the onset is acute, there is a simultaneous polyarthritis, or several joints are involved successively. The spine, temporomaxillary and interphalangeal joints are apt to be involved. Those affected are swollen, perhaps with a little serous effusion, hot and tender, and there is moderate hyperemia, or a bluish-red discoloration. The association of high fever, sweating, the appearance of prostration, extreme pain and rapid muscular atrophy, and the signs referable to the joints themselves, all unite to simulate the picture of acute articular rheumatism. It is in these cases that *Heberden's nodes* are of great value, if by any chance they are present. Subsequent attacks of varying severity are followed by permanent alterations in the articulations.

Much more frequently, the disease is gradual in its onset, although an acute attack may initiate the disease or occur at any time during its course. In fact, exacerbations and remissions are the rule. One or two joints, especially the interphalangeals, become very slowly enlarged, accompanied by pain or aching sensations, with intermittent redness. Within a short period, other joints are in-

volved, with hypertrophy of the bony prominences, restriction of mobility, and the occurrence of creaking and grating sounds upon active and passive motion. In late stages, there may be ankylosis and contractures. The regional muscles after some time become atrophied, rendering more prominent the changes in the joint, while nutritional disturbances of the skin are also frequent. The hypertrophied phalangeal bases—Heberden's nodes—are diagnostic, and are usually associated with ulnar deviation of the phalanges and partial flexion of the joints. They may, however, exist alone. Or, a chronic monarticular arthritis of a single joint, hip or shoulder particularly, is the only clinical evidence of arthritis deformans.

(b) *Atrophic arthritis*, in which destruction and absorption are foremost, occurs mostly in adolescence and early adult life, being rare before the age of fifteen. Females are more often affected than males. The chronic, progressive and polyarticular nature is the same as that in the hypertrophic form, although the course is somewhat rapid.

(c) *Still's disease* is the atrophic polyarthritis of childhood and is more common in boys. The onset is acute, with fever, pain and monarticular arthritic symptoms. It progresses rapidly to other joints, producing moderate effusion, pain and tenderness, impaired function and periarticular thickening. The lymph glands are enlarged and in many instances the spleen is palpable; at times the urine shows signs of nephritis. The entire aspect in the severe cases is aptly characterized by Osler's summary of the most acute forms of arthritis deformans in the adult.

Intermittent hydrops is a peculiar affection, consisting of a recurrent joint effusion, confined to one or both knee joints. The onset is acute, with pain and impaired function, and the knee joint very suddenly becomes distended with fluid. Vasomotor disturbances and erythema are often associated. After three or four days, during which period the general condition remains unaffected, the swelling disappears, only to recur with almost habitual regularity after a certain interval. This interval is usually ten to twelve days but may be as long as three or four months. Women are especially affected.

Chronic serous synovitis results from trauma, antecedent acute synovitis, or a prolonged joint disease such as syphilis or gonorrhea. Trauma is the greatest factor. After the acute stage of traumatic synovitis, the joint continues to be somewhat puffy and contains a little serous fluid. Or, absorption is complete, but moderate effusion recurs at irregular intervals. Function is gradually impaired. The condition is afebrile and practically painless. Chronic serous synovitis is symptomatic in tumors and in lipoma arborescens.

Villous Arthritis.—Pathologically a villous arthritis or hypertrophy of the synovial villi occurs in some types of arthritis deformans. It is then, however, part of a chronic progressive polyarthritis. On the other hand, chronic arthritis of a villous nature is sometimes monarticular, affecting particularly the knee joint, and is to be distinguished by its local character and the absence of general symptoms.

Hemarthrosis or spontaneous hemorrhage into a joint cavity occurs, as a rule, in infants and children and almost exclusively in males. The condition is an evi-

dence of hemophilia and there may be a family history of bleeding. Slight trauma incites a sudden effusion into a joint, or the joint becomes swollen without antecedent injury. The skin is warm, sometimes reddened, and frequently the temperature rises moderately. There is impaired function because of the presence of fluid, but movements are not very painful. Several joints may be involved in succession. The facial pallor, subcutaneous ecchymosis, and the personal or family history of bleeding, suffice to make the diagnosis. Aspiration of the joint discloses a bloody fluid. This fluid, after some time, is entirely absorbed, or some limitation of motion may result from intra-articular adhesions. Subsequent chronic periarticular thickening about a joint suggests tuberculosis, and requires differentiation from that disease.

Hemorrhage may also take place into a joint cavity in *scurvy*, although the bleeding is more likely to overlie a joint or occur in the epiphyseal region of one or more of the long bones. The tender, enlarged epiphyses; swollen, spongy gums; and the history of dietetic error, as well as the improvement under a rational diet, will differentiate the two.

Two other factors which must be included when hemorrhagic fluid is aspirated are (1) a joint injury without an underlying contributory cause and (2) malignancy.

Neuropathic Arthritis.—Neuropathic arthritis occurs in a variety of diseases of the central nervous system. The joint conditions are chronic in progression and associated chiefly with tabes, syringomyelia, Morvan's disease, poliomyelitis, hemiplegia and neuritis.

The characteristic arthropathy of tabes is known as *Charcot's joint*. This comes on suddenly with a serous effusion into a single joint. A slight trauma often precedes. The knee is most often involved, then the hip and shoulder. The absence of pain and tenderness and of inflammatory signs forms a marked contrast to the sudden onset with effusion, the fluid often being so extensive that a flapping, unrestricted passive motion results. The course is chronic, during which time the joint structures become either hypertrophied or atrophied. The consequence, then, is either a distended, disorganized joint with undue mobility, or a disintegrated articulation with regional muscular and ligamentous atrophy and the production of a flail joint. The diagnosis is easily made by the Argyll-Robertson pupil, loss of reflexes, ataxia and other signs and symptoms, mentioned above.

Syringomyelia produces very similar arthropathies but is more likely to affect the upper extremity, and the joint manifestations are more common in men while Charcot's joint is most frequently seen in the female. The loss of pain and temperature sense with the preservation of tactile sense; the muscular atrophy in the hands, with spastic symptoms in the legs; and the presence of trophic lesions are the important diagnostic points. In *Morvan's disease* (a variety of syringomyelia) the arthropathy is associated with complete anesthesia, and with more extensive and destructive trophic phenomena and infections.

In *infantile paralysis*, as a result of a flaccidity of certain muscle groups with overaction of their antagonists, various arthropathies develop. These include hyperextension, flail joints, dislocations, contractures and other deformities. The etiology must be derived from the history and the testing of muscle function.

Symptom	Traumatic Synovitis (Sprain)	Subluxation of Cartilage and Floating Cartilage	Osteo-Arthritis	Rheumatic Fever
Age	Any.	Especially young adults.	45-60.	Especially in children and young adults.
Site of frequency	Knee.	Knee.	Males: Especially larger joints—any. Females: Especially smaller joints—any.	Larger joints or smaller ones, in connection with larger. Successive enlargement of joints.
History	Ensues shortly after injury.	Usually, symptoms are not produced immediately following injury, but occur after next slightest trauma to joint, to be repeated in weeks or months afterwards. Recurrent attacks may finally bring on definite joint locking.	Injury or exposure. Possibly extravagant living.	Tonsillitis predisposes and often immediately precedes. Tendency toward recurrence.
Subjective signs and symptoms	Pain may or may not be present. Generally sense of distention rather than actual pain.	Pain is not present at first, but when leg becomes partly or completely fixed, pain is intense.	Pain, slight at first increases as bony changes advance; often follows nerve trunks, rather than in joint; worse at night; aggravated by movements. May be paroxysmal. Affected by weather.	Pain usually very severe and constant. High rise in temperature.
Description of swelling	Elastic, fluctuant, single, rather irregular, about whole joint. Skin taut and shiny. Bony prominences fairly normal in outline. Signs of trauma usually absent. Tenderness slight or marked.	Fluctuant, single, regular, about joint. Skin, at times, taut and shiny. After repeated attacks, crepitation may be felt. Not tender, unless locking.	Marked joint distortion as disease progresses, due to bony deformities, atrophied muscles, etc., with scattered bogginess. No fluctuation. Motion only impaired, "clinical stiffness" develops. May be crepitation. No tenderness.	Uniform non-fluctuant swelling about joint, with an overlying reddened skin; joint is "hot." Tenderness is pronounced.

OF JOINT SWELLINGS

Acute Arthritis	Syphilis	Tuberculosis	Symptom
Any.	Young adults. Adults.	Especially in children. Early adult life.	 Age
Primary: Any. Secondary: Ankle, knee, hip (staphylococcus or streptococcus). Knee (pneumococcic) sternoclavicular, sacro-iliac, intervertebral, temporomaxillary (gonorrheal).	Charcot's joint: Knee, hip, shoulder. Syphilis: Knee.	Hip, knee, ankle, elbow. Any joint.	... Site of frequency
Injury, infected wounds. In the course of, or following an acute infectious disease. May come on suddenly without apparent cause. Follows gonorrheal urethritis. Suddenly with serous effusion in joint.	Often slight trauma. Syphilis or locomotor ataxia.	Often slight or extensive trauma. Possibly tuberculous history.	 History
Pain is usually very severe and constant. Septic temperature. All constitutional signs of very severe septic condition.	May be signs of syphilis or locomotor ataxia; no pain; no temperature. In acute form of syphilis may be pain.	At first there may be no pain, then slight and may be somewhat distant from joint. In later stages, severe. More severe at night, and increased on joint movements. Moderate rise in temperature. Possibly other signs of tuberculosis.	 Subjective signs and symptoms
Fluctuant or tense, reddened skin at first; diffuse and tender about joint. As disease progresses, crepitation and joint stiffness. Movements cause exquisite pain. Pneumococci, typhoid and gonorrheal type, usually single. Staphylococcus and streptococcus type, multiple.	Effusion is so extensive as to give to the joint a flapping, unrestricted passive motion effect. Fluctuant swelling about whole joint. Later on, hypertrophy of structures, with marked deformity of joint.	Concealment of bony prominences. Skin over affected joint, milky white, shiny. Superficial veins pronounced. Mass, usually soft, doughy, in areas "spindle shaped." Semi or completely fluctuant. May be crepitus and sinuses. At first, tenderness absent or slight, later may be severe, especially on movements. Single; exceptionally multiple.	... Description of swelling

Symptom	Traumatic Synovitis (Sprain)	Subluxation of Cartilage and Floating Cartilage	Osteo-Arthritis	Rheumatic Fever
Special data ..	Purely a local condition. Constitutional disturbances absent or very slight. Radiograms only reveal joint distention. Aspirated fluid sterile; usually clear and straw-colored.	May have sudden joint locking. No constitutional symptoms. Radiograms may or may not show cartilage. In the majority of cases negative. Aspirated fluid sterile; usually clear and straw-colored.	Radiograms show joint changes.	Endocarditis and pericarditis common. Constitutional disturbances severe and alarming. Aspirated fluid, clear. No definite organisms found.

Lipoma Arborescens

Lipoma arborescens affects the ankle joint or knee, and consists of a lipomatous infiltration of the synovial villi. It is evidenced clinically by the presence of a soft, lobulated, subcutaneous mass which is apparently intimately related to the joint. The most frequent site is beneath one of the malleoli, while in the knee it is often palpable. A chronic arthritis may be associated and the condition may be painful.

Baker's Cysts

Baker's cysts are really herniæ of the synovium through the fibrous capsule, and occur particularly about the knee joint where single or multiple, firm or fluctuant, rounded bodies appear. The size varies greatly and the cysts are not necessarily in close relation with the joint. Moderate pain and interference with motion are the only symptoms; these symptoms are often absent.

Tumors of Joints

Tumors of joints are rare. Chondroma and osteoma arising in the extra-articular tissues may invade the joint. The symptoms are gradual swelling and restriction of the joint, with perhaps effusion. If a tumor mass is palpable it is hard, regular or irregular and fixed. Lipoma is more common than either of the above and arises beneath the synovial membrane, in contradistinction to lipoma arborescens. It produces a slowly increasing joint enlargement, which on palpation feels soft and doughy. A few cases of primary sarcoma of the articulations have been reported. They are so rare, as primary tumors, that discussion is unnecessary.

Contractures Due to Hysteria

Hysteria sometimes affects one or more articulations. The symptoms attributed by the patient to a disease of the joint are pain, paresthesia and stiffness. Objec-

JOINT SWELLINGS (*Continued*)

Acute Arthritis	Syphilis	Tuberculosis	Symptom
Radiograms may or may not show joint changes. Blood culture often positive. Suppuration common. Leukocytosis.	Positive Wassermann and cerebrospinal fluid. Possible beneficial reaction to antisyphilitic treatment. Argyll Robertson pupil. Loss of reflexes. Ataxia.	Tuberculin reaction. Possibly tubercle bacilli from aspirated fluid. Night-sweats.	Special data

tively, there are apparent pain and tenderness and rigidity upon attempted passive motion, the joint often being held in an attitude of partial contracture. The disproportion between the complaints and the physical signs; the personality of the patient; the multiplicity of symptoms; and the detection of hysterical stigmata point to the true nature of the condition. The muscle spasm disappears during narcosis, and radiography will exclude many possibilities.

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CHAPTER XII

FRACTURES AND DISLOCATIONS

FRACTURES

Definition.—A fracture is a solution of continuity of bone, and is commonly called a break.

Frequency.—According to Tanton (*Fractures*, J. B. Baillière et Fils, Paris, 1915, pp. 10-11), fractures occupy a little more than one-seventh of all of the traumatic lesions of the body. They are ten times more common than are dislocations. The humerus is most frequently injured, while the two bones of the leg, the femur and the two arm bones follow respectively.

Age.—The majority of fractures occur between the ages of twenty to fifty years. Their occurrence is rare in the infant owing to the flexibility of the skeleton, the smallness of the bones, and the weak musculature which serves as such feeble levers. On the other hand, the fragility of the skeleton in the aged, due to senile osseous porosis and to the small proportion of those living beyond the normal expectancy, gives the impression, and rightly, of the common occurrence of fractures in advanced life. Epiphyseal separations or fractures are found in the young, while the "fractured hip" of old age occupies the most important place in fractures of the aged.

Sex plays an important rôle only in that the male is subjected to a far greater number of accidents than is the female.

Heredity has probably some influence on the occurrence of fractures, but this most especially applies to inherited diseases.

Etiology.—In considering the causation of fractures, two great factors must be considered: (1) The force exerted and (2) the resistance of the skeleton to withstand such force.

The force or violence may be (1) direct or (2) indirect or by contrecoup. By direct violence is meant that the bone is fractured at the point of the application of the violence; by indirect the fracture is at a distance from the point of violence.

Classification.—*Etiologic.*—Two great groups of fractures, from the standpoint of etiology, exist. They are: (1) Traumatic fractures, or those caused by violence from without; (2) spontaneous or pathologic fractures, or those occurring with slight or no external injury. In these conditions the bone has become porous or fragile through disease, *i.e.*, malignant bone tumor, rachitis, the granulomata, bone cysts, inflammatory conditions, tabes, paraplegias and the like.

Anatomic.—(1) Fractures of the shaft or diaphysis. (2) Fractures of the epiphysis, including the articular surfaces.

Based on Direction of Line or Lines of Separation.—(1) Longitudinal, (2) oblique, (3) transverse, (4) spiral, (5) comminuted, (6) stellate, (7) T-fracture, (8) gunshot, (9) penetrating.

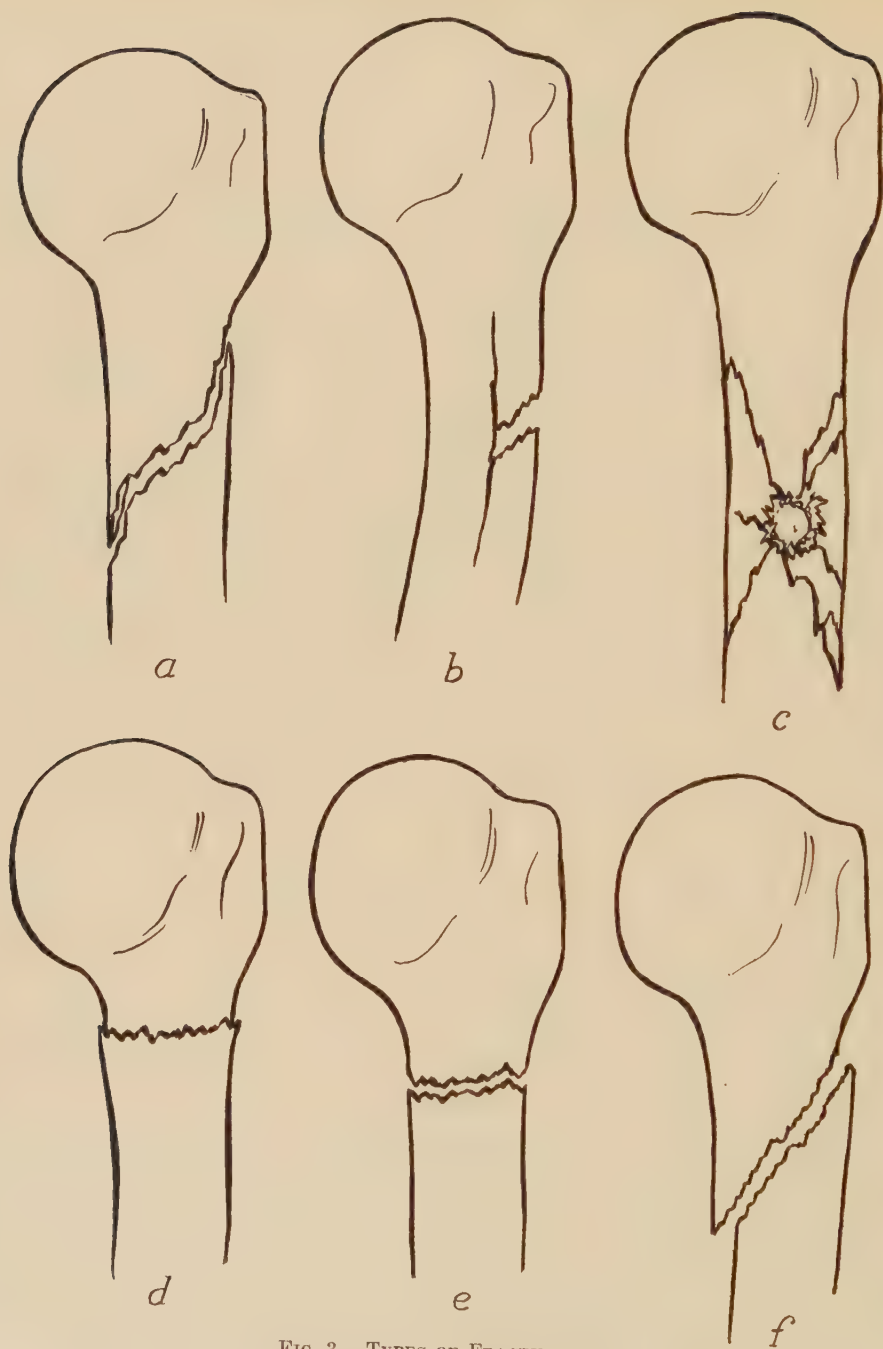


FIG. 3.—TYPES OF FRACTURES.

(a) Spiral; (b) greenstick; (c) gunshot, comminuted; (d) impacted;
(e) transverse; (f) oblique.

Based on Existence of Communication of Bone with External Surface, by Way of Skin or Mucous Membrane.—(1) Simple. (2) Compound.

Based on Existence of Penetration or Compression of One Fragment in or upon Another.—(1) Non-impacted. (2) Impacted. (3) Infracted. A non-impacted

fracture is one in which there is no penetration of one fragment into another. An impacted fracture is one in which there is penetration of one bone into another. An infracted fracture is an impacted fracture, compressed into itself on the concave side. It is unusual but may be found in rachitic or other soft bones.

A "greenstick" fracture is an incomplete fracture with separation, limited to one side which becomes convex, while the opposite side is concave.

A complicated fracture is one in which other important tissues such as nerves and blood-vessels are injured.

The displacement of the fragments may be lateral, angular, with overriding, with axial rotation overlapping and angular combined, or with great separation.

Fractures may be further classified as to the bone involved. Such classification is considered in detail in the following pages.

History

Before a physical examination is attempted, important facts relating to the injury should be ascertained, if possible. They are as follows:

Personal History.—Description of accident, including type of force exerted and was it produced by direct or indirect violence; position of body and bone injured, at time of and immediately following the accident; sensation experienced at time of accident such as "snapping sound," crunching, and the like. Was there immediate or subsequent loss of function? Was deformity noted immediately following accident and did patient or bystander aid in "snapping or putting back" a protruding bone? History of previous accident which might have been the cause of a presenting deformity. History of previous fractures or dislocations. Pain, type and radiation at time or immediately following and subsequent to the accident.

Physical Examination.—*Inspection.*—If possible, remove sufficient clothing from patient so that a thorough inspection of the injured part and the corresponding limb on the uninjured side, including surrounding areas, may be made. Have good light and place both limbs in same position and immediately compare the injured limb by inspection with the corresponding uninjured one. Look for signs of trauma such as ecchymosis or skin redness, evidences of abrasions or lacerations, any particular area, even very small, whose color is different from that of the surrounding skin; swelling and impairment of function. While examining by inspection request patient to mention any site of particular pain which is occasioned by any particular movement. Look for deformity and apparent shortening.

Palpation.—Carefully and gently pass hand over injured bone to determine any soft tissue or bony deformity, sites of tenderness and extravasation of blood. Ascertain if possible the site of fracture, direction of the fragments and the extent of the displacement. To determine crepitus or abnormal mobility, grasp the bone fast above suspected area with one hand, while the other hand holds the bone just below the injured area, then gently move the bone to and fro, to detect mobility; this motion may be gradually increased. Radiographic examinations should preclude too vigorous manipulation.

Measurements.—The examiner should be familiar with the bony landmarks, and all measurements should be made from like points on both sides, with the body as straight and as even as is possible. A metal tape, and in some instances calipers, are to be preferred to the popular cord or string so often used. Separate measurements are discussed under special fractures. Radiographs should, if possible, be made in all cases of suspected fractures or dislocation. Too much stress cannot be laid upon the importance of two views being taken, perhaps more, for each suspected case.

Fractures of the Skull

Fractures of the skull are divided anatomically into those of the *vault* and those of the *base*. This classification is also applicable clinically, as the two varieties generally present a different symptomatology. Skull fractures may be single or multiple; simple or compound; fissured, linear, “bursting” type, stellate, comminuted, perforative type, depressed or merely of contact or grooved character. While fractures of the vault may be either simple or compound, those of the base are almost always compound since continuity with the nose, pharynx or external auditory canal is usually established. A fracture of the vault of the cranium will often extend into one of the basilar fossæ as well.

Etiology.—Skull fractures have become exceedingly common, chiefly because of the almost universal use of the automobile as a means of transport, and the increased risks among men engaged in the building trades. Males predominate on account of greater frequency of exposure to injuries. Although adults are injured most frequently, figures as to age groups are untrustworthy. Porotic conditions of the skull bones, for example, syphilis, contribute to the incidence of fractures from minor traumata.

Frequency of Site.—Fractures of the vault constitute approximately three-fifths of all skull fractures; about two-thirds of basilar fractures originate in the vault and involve the base by continuity. They predominate in the middle fossa. Fractures of the posterior fossa are least common, because of the thick and well-protected bony area about the foramen magnum.

Mechanism of Displacement.—Fractures of the vault are due to direct injury, as from blows, falls, crushing, penetrating instruments or missiles. A scalp wound may or may not be associated. The force exerted to produce a fracture may be either small or great. Seemingly trivial injuries may produce a fracture of the skull in certain individuals. Since the skull is comparatively globular, and for the most part a closed structure, the lines of force are not estimable; thus a fracture may directly underlie the site of trauma to the scalp, may be contiguous therewith or may occur at some distance from it. A blow on the vertex may also be responsible for a fracture on the opposite side, or even in the base of the skull. In general, the location and direction of the causative force do not predetermine the site, nature or extent of fracture. In the adult, one or both tables of the skull can be fractured by either blunt force or penetrating injuries. In the child, because of absence of the diploë, such a distinction cannot be made. In so-called “bursting” fractures, trauma is severe, and the force is commonly transmitted with greatest intensity against the fissures; although linear fracture may occur first, a continuation of the trauma produces marked spreading of the fracture

line. Comminution is the rule in penetrating injuries of the skull, such as those caused by bullets, though it may occur from blunt force. A fractured vault is rendered compound when there is a coexistent wound of the scalp and, also, when the fracture extends into the wall of a frontal sinus. As a rule, the frontal sinuses are undeveloped in childhood, so that a fracture of the supra-orbital region is not necessarily compound during this period of life. The skulls of children frequently withstand severe trauma without fracturing. This is explained by the unfixed and unossified fissures, and the elastic, yielding character of the bones themselves. Depressed fractures, however, are fairly common.

Fractures of the base of the skull arise principally from direct trauma and by agencies similar to those causing vault fractures. They are less frequently produced by falls upon the heels or buttock, causing the cervical spine to be jammed against the margins of the foramen magnum, and by blows on the jaw which are transmitted upward through the condyles of the mandible, fracturing the thin plate of the glenoid fossa. Most basilar fractures are in communication with the external air by way of the ethmoidal or sphenoidal sinuses, the nasal cavity, or the pharynx or the external auditory canal, and are therefore compound fractures. Unlike similar occurrences in the cranial vault, basilar fractures are related with the offending force, as they occur in the same direction as the force. Single and multiple fractures are seen. Most of them are fissured in type, but considerable displacement is occasionally found. When multiple, communication between the fractures is often noted. Comminution may take place in this fashion, and also occurs in some fractures induced by falls on the buttock or blows on the chin. A basilar fracture may be confined to one fossa, or it may extend into a neighboring fossa, or traverse the entire base.

Local Symptomatology.—In open wounds of the scalp, the skull may be directly inspected by retraction of the wound margins. Cerebrospinal fluid and brain tissue may escape from the wound. Depression is often recognized by direct inspection, and can sometimes be palpated when the scalp is intact. When no wound is present, one often sees evidences of contusion and detects a soft, boggy swelling of the scalp. In basilar fractures, this is frequently found about the mastoid region. An hematoma of the scalp offers difficulty in diagnosis, as the central portion often feels like a depressed fracture upon palpation. Ecchymosis occurs from direct blows, and also develops secondarily to fractures. It appears about the orbits in cases of anterior fossa fractures. In fractures of the base from gunshot wounds and penetrating objects, the wound of entrance should be sought on the face, about the orbit, in the mouth and pharynx, and about the upper part of the neck.

General Symptomatology.—Aside from the questions of compound fractures, depression and extensive comminution or bone defects, interest in fractures of the skull, from a clinical standpoint, is centered in the signs and symptoms of *concomitant brain injuries*. That is, the important factors in the production of symptoms, as well as in the present and future welfare of the patient, usually reside in the highly specialized brain, its intracranial coverings and its associated vascular structures; whereas the character, location and extent of skull fractures are necessarily subordinate, and assume importance only in relation to their effects, or possible effects, upon the underlying structures.

A certain group of fractures of the skull presents none of the usual symptoms.

Trauma is relatively slight, and consciousness is not disturbed. The patient is often dazed momentarily, but soon recovers. Later, perhaps several hours, headache and vertigo appear, and other symptoms of increased intracranial pressure may become manifest. Or, he may progress to ultimate recovery without unusual incident. Minimal functional disturbances of the cranial contents may be observed not only in the presence of minor linear fractures, but also in some of the more severe fractures. In military surgery it is not unusual to find perfect cerebral function associated with certain types of compound, comminuted fractures in which important vessels and brain areas have escaped injury by the missile.

The rule in fractured skulls, however, is to have associated symptoms of cerebral concussion or compression and, occasionally, those of cerebral contusion or laceration, or of meningeal hemorrhage. The patient becomes immediately unconscious, frequently vomits, and is seen shortly after injury with symptoms of shock—pale face, cold extremities, rapid, feeble pulse, accelerated respirations of regular or irregular type, subnormal temperature and lowered blood-pressure. From this condition the patient may pass into a hopeless state, characterized by profound disturbances of the vital centers; or he may react favorably, with vasomotor readjustments and decrease in the degree of unconsciousness. When improvement takes place, the pulse becomes slower and the blood-pressure rises. This sequence is essentially the picture of cerebral concussion, providing unconsciousness is temporary. If unconsciousness is prolonged, is associated with falling pulse and rising blood-pressure, or becomes of deeper intensity and verges upon or actually becomes complete coma, then the state of cerebral concussion has changed into that of cerebral compression.

Contrarily, cerebral compression may dominate from the onset. This may be in association with meningeal or intradural hemorrhage, or rupture of one of the venous sinuses; it also occurs frequently in conjunction with contusions and lacerations of the brain and with cerebral edema.

The condition of the brain may be gauged by thorough and frequent observations of (1) impaired consciousness; (2) behavior and mental reactions, if conscious; (3) muscular and reflex functions; (4) medullary functions; (5) mechanical alterations in respect to the eye-grounds, blood-pressure and spinal fluid tension, and (6) cranial nerve functions.

Impaired Consciousness.—All gradations may be met with, varying from a stunned and mentally bewildered condition to complete coma. Ordinarily, the less severe the cerebral injury the earlier is the return to consciousness. Response to external stimuli indicates partial cerebral function. Temporary unconsciousness is, in general, much more favorable than a prolonged period. Initial coma and deepening semi-coma are indicative of severe injury or progressive hemorrhage. Some cases are seen in which symptoms of increased intracranial pressure are present from the onset. A lucid interval, followed by a second period of unconsciousness, is typical of meningeal hemorrhage.

Behavior and Mental Reaction.—The original unconscious state is often followed by cerebral excitement, characterized by excessive muscular movements, uncontrollable activity in some cases, and by muttering or wild delirium. Mental reactions can only be studied when unconsciousness has receded. Retrograde amnesia is very common. Other mental activities may be clear or confused. Focal lesions pro-

ducing aphasia and dysarthria, for example, must be considered in interpreting the mental status of an individual. In the subsequent course, permanent disturbances of such functions may be observed, and persistent memory and intelligence defects and even insanity may develop.

Muscular and Reflex Functions.—These are in complete abeyance in coma, which may also be accompanied by loss of the organic reflexes. In semicomatose and stuporous states, resistance to passive motions is often noted. Facial paralysis, hemiplegia and hemiparesis are not uncommon findings in fractured skull. These may be the result of depressed fractures, of nerve compression, or of focal lesions (contusion, laceration, hemorrhage) of the motor area. Palsy of the ocular muscles is much less common. Exaggeration of the tendon and cutaneous reflexes occurs in conjunction with irritative lesions; diminution and absence of these, with paralytic lesions and cerebral compression and muscular twitching are manifestations of focal brain injuries and are of value in localization. The same is true of attacks of jacksonian epilepsy. Abnormal restlessness and motor activity have been mentioned. The importance of physical unrest is the exhaustion which it induces.

The condition of the pupils is highly informative. In irritative lesions they are contracted; in paralytic and compression states, and in most instances of unconsciousness, they are dilated. When unequal, the more dilated pupil is usually on the side of the cerebral injury. The eyeballs may deviate toward this side, also. In complete coma, the pupillary light reflexes are absent.

Medullary Functions.—The vital processes of respiration and cardiac action are frequently affected. Rapid breathing, stertorous respiration, irregularity in rhythm, abnormal slowing of the rate, and cyanosis are all indications of medullary disturbance—compression, contusion and edema. Similar alterations in the cardiac action may be interpreted in the same manner, although initial rapidity of the pulse may be due to either shock or hemorrhage, as well. Compression is accompanied by a gradual or rapid decrease in pulse rate, with rising tension.

Special Data.—The eye-grounds are available as an index of cerebral compression. Increased intracranial tension is indicated by swelling of the nerve head, and engorgement of the retinal nerves. Advanced cases of cerebral compression produce choked disk. The blood-pressure is reduced in the presence of initial shock. It increases when compression develops, and its elevation is in proportion with the intensity of the compression.

The tension of the spinal fluid is also increased in compression states. Rating the average tension from six to ten, elevations beyond this may be considered pathologic. These figures refer to displacement of millimeters of mercury. Aside from pressure observations, gross blood in the spinal fluid is to be noted in cases of intradural hemorrhage.

Cranial Nerve Functions.—The nerves most frequently injured or compressed are the facial and the auditory; less commonly, the oculomotor and abducens. Any of the remainder may be involved, of course. The special senses cannot be tested in the presence of unconsciousness, but facial palsy and paralysis of the ocular muscles can be detected by inspection. Usually the nerves are implicated at the base of the skull, in connection with basilar fractures; isolated traumatic lesions in the motor area and the nuclear regions will produce the same effects.

In fractures of the base of the skull, certain symptoms are added to those of

the general skull and brain injury. The most noteworthy symptom is external hemorrhage. This occurs through the nose, mouth and ears, individually or collectively. Of these three sites, hemorrhage from the ear is most significant, although caution must be used to rule out bleeding from an injured external ear or ruptured drum-membrane. Blood escaping into the pharynx may be swallowed and later vomited. The escape of cerebrospinal fluid through the ear or nose is diagnostic; in the early stages of injury, however, it is mixed with blood and cannot be easily identified. Hemorrhage may be moderate or profuse. In some instances it is sufficient to adequately allay, or even prevent, cerebral compression.

The nerves at the base of the skull may be contused, lacerated or compressed by hemorrhage and edema. Facial palsy and deafness are the most common disturbances.

Complications of Fractured Skull.—Immediate or impending complications include:

- Cerebral concussion
- Cerebral compression
- Cerebral contusion
- Cerebral laceration
- Cerebral edema
- Meningeal hemorrhage
- Intradural and venous sinus hemorrhage
- Meningitis

Contusion and Laceration.—These conditions of the brain have been referred to. They are most serious when affecting the medulla, and least serious in the “silent” cerebral areas. Complete consideration of these conditions would embrace the entire field of cerebral localization. In the unconscious period, they can be recognized by the appearance or development of localized muscular and nerve disturbances. These present as the clinical form of paresis, paralysis, twitchings or convulsions, and alterations of the special senses. Practically, such symptoms can usually be localized in the motor or other particular areas of the cerebral cortex. Penetrating injuries may affect the nerve-fibers and cells in any location.

Cerebral Edema.—This is a constant accompaniment of brain injuries. Its degree varies with the severity and diffusion of the injury, and, also, with the remedial measures employed—or not employed. It is responsible, in part, for cerebral compression. It always obstructs, and may prevent, cerebral functions, and must be given serious consideration in both prognosis and treatment.

Meningitis.—This constitutes a grave complication of compound fractures of the skull in any situation. The pyogens are the usual invaders. Meningitis must always be considered as a possible sequel of all fractures of the base of the skull and of all compound fractures of the vault, even when external hemorrhage has not taken place.

Meningeal Hemorrhage.—While this may be the source of serious brain compression from the onset, with prolonged interruption of cerebral functions, yet it is generally a secondary and somewhat clinically delayed occurrence. Hence, in the typical instance, bleeding from the meningeal vessels is characterized by immediate unconsciousness, a lucid interval and a second period of unconsciousness, in chronologic sequence.

Intradural hemorrhage can be identified by the presence of gross blood in the cerebrospinal fluid. Bleeding from the venous sinuses can be inferred from the location of the fracture, known sites of depressed fracture, the apparent courses of penetrating objects and visual observation in the presence of scalp wounds with underlying defects of the skull.

For discussion, see the foregoing and also Differential Chart.

Remote complications include:

- Epilepsy
- Cerebral abscess
- Chronic subdural hematoma
- Cerebral tumor
- Insanity
- Chronic meningitis

Radiography.—The Roentgen ray is the final and conclusive mode of diagnosis in some fractures of the skull. It should be employed in all instances of trauma to the skull. Stereoscopic pictures are necessary to accurate interpretation. It will fail to disclose a certain percentage of basilar fractures. The clinical findings in this group are, fortunately, quite distinctive.

Differential Diagnosis.—Details of differential diagnosis will not be entered into. It is sufficient to remark that various causes of unconsciousness, other than fractured skull, must be considered. Important among these are alcoholism, uremia, diabetic coma, apoplexy, hemorrhagic pachymeningitis, cerebral tumor and certain drug poisonings, notably opium and its derivatives.

Fractures of the Malar Bone

Etiology.—Fractures of the malar bone are due to direct blows on the face or cheek but rarely occur alone, because the compactness of the bone forms a protection to the orbit, upper jaw and maxillary antrum. Such fractures are found associated with those of the zygomatic arch or maxilla. Sutural fractures at the junction of the malar with the temporal (zygomatic arch) and the maxilla are very rare but produce a definite deformity. Breaking of the arch alone is also rare and caused by blows or falls on sharp objects.

Frequency of Site.—Fractures of the malar body proper are the most frequent, the bone being crushed inward and toward the maxilla.

Mechanism of Displacement.—In practically all fractures of the malar bone the inner edge is rotated upward, and the outer edge downward, the center of the rotation being nearly the center of the bone. The outer zygomatic edge is drawn downward by the zygomatic head of the quadratus muscle, the zygomaticus and principally by the strong masseter. This forces the inner edge upward and toward the orbit where the chief deformity is easily palpated.

Examination.—To examine for a fracture of the malar bone the face should be carefully inspected for deformity in the region of the cheek and along the lower border of the orbit. The injured side should be compared with the normal. Then, while standing behind the patient, the malar region is palpated, any depression is noted and an attempt is made to move the bone upward and down-

ward between the thumb and finger. The examination should be made as soon as possible following the accident on account of subsequent swelling obscuring the signs.

Symptomatology.—Following a fracture of the malar bone there will be pain in the cheek on the involved side and localized tenderness, increased on severe pressure and on widely opening the mouth. Ecchymosis over the site of fracture occurs early with extension to the orbit, eyelids and even conjunctiva. Swelling is not long delayed, so there may be a masking of the original deformity which is the most important sign. The entire malar bone may be depressed and its normal prominence lacking above the cheek. There may be a hollow to the outer side and below the eye and rarely the fracture line may be palpated. Abnormal mobility and crepitus may, at times, be found. Following a fracture into the maxillary antrum there is moderate epistaxis, and after extension of the fracture line into the infra-orbital foramen there are paresthesiæ such as prickling of the upper gums, upper lip and skin of nose and cheek.

Complications.—Injuries to the eye, temporal and masseter muscles, infra-orbital nerve and fracture of the coronoid process of the mandible. The maxillary antrum may be entered, but infection is a rare sequel.

Fractures of the Nasal Bones

Etiology.—Fractures of the nasal bones are usually the result of direct blows or violence received in falls. Under this heading are included injuries to many structures in this region, namely, the nasal bones, the nasal portions of the frontals and superior maxillæ, the vomer, the lacrimals, the perpendicular plate of the ethmoid, the nasal septum and lateral cartilages.

Frequency of Site.—Fracture of the nasal bone proper is usually transverse and about one half inch from the free margin. Fractures of the nose in general are often comminuted, usually compound.

Mechanism of Displacement.—There is no muscle action involved in the displacement of the fragments which are either pushed backward causing a flattened nose, or more generally to one side.

Examination.—Examination for fracture of the nose usually requires only inspection because of the marked deformity. After a few hours when swelling has obscured the displacement, palpation and manipulation may be necessary. This should be carried out under an anesthetic, either local (cocain) or, preferably, general. Beside manipulating the nose for abnormal mobility and crepitus the nares should be inspected with a speculum for injury to the mucous membrane or displacement of the septum.

Symptomatology.—Physical signs and symptoms easily lead to a diagnosis in a recent case. There are pain and tenderness at the site of fracture with deformity of the nose, either widening, or displacement laterally. In practically every case there is bleeding from the nose. After sufficient time has elapsed for swelling to occur, the exact deformity is difficult to make out. But here again, pain and tenderness are present and the marked swelling should aid in diagnosing a fracture. Tears may flow down over the cheek (epiphora), if the lacrimal duct has been ruptured. When the septum is involved and especially with resultant swelling there

is difficulty in breathing. There may be deep-seated pains in the forehead and face due to interference with the sinus outlets. Subcutaneous emphysema over the upper face may be present.

Complications.—Complications of fracture of the nose are many. There may be severe hemorrhage, subcutaneous emphysema from extension of the fracture line into the frontal sinus, or epiphora from laceration of the lacrimal duct. There may be marked deviation of the tip of the nose; or extension of the fracture into the anterior fossa of the skull with resulting cerebral symptoms. An abscess may form in the nose followed, at times, by a periostitis and perichondritis with sloughing of bone or cartilage. This is recognized by a persistent fetid odor and purulent discharge with dull pains in the nose. Not one of these complications is common.

Fractures of the Superior Maxilla

Etiology.—Fractures of the superior maxilla are the result of direct blows, crushing injuries and gunshot wounds. They are usually associated with severe injuries to other bones of the face, particularly the malars. When struck directly, the maxilla is very liable to break but a complete separation requires extreme force. These fractures are often complications of other fractures, and vice versa, and may extend to involve the other bones. Fractures of the alveolar process occur in the act of extracting teeth; they may be limited to one tooth or radiate to involve most of the alveolar plate. Extraction of the third molar tooth is especially liable to be complicated by a fracture of the tuberosity of the maxilla with an opening up of the maxillary antrum.

Frequency of Site.—Fractures of the body are very uncommon as compared with those of the processes, especially the alveolar process.

Mechanism of Displacement.—All vary much in degree, from a small separation of a portion of a process to an extensive comminution of the whole bone. When the body is involved the fracture line is either a simple fissure or more commonly an irregular comminution, extending to the antrum. The upper fragment is driven upward toward the orbit or inward into the antrum. One maxilla may be completely separated from its fellow on the opposite side or the alveolar process may be split transversely from the body of the bone.

Examination.—To examine for fracture of the maxilla, inspection only is often sufficient, especially if the mouth is opened and the line of the teeth noted. A bleeding wound of the mucous membrane should be looked for. Crepitus may be elicited by moving the jaw between the fingers on either side of the bleeding wound. External inspection and palpation will usually show a fracture of the body.

Symptomatology.—Pain in the region of the inner portion of the cheek or the upper teeth, with tenderness localized to these regions are very constant findings in fracture of the maxilla. At first there may be cerebral symptoms as concussion or skull fracture from the severe injury. Deformity is usually obvious, the cheek sunken and the upper teeth out of alignment. After a short time extensive swelling occurs so that the cheek appears swollen and the eye may be closed. There may be epistaxis or emphysema from injury to the maxillary antrum and there is practically always an open wound in the mucous membrane of the upper jaw. An hematoma may form beneath the cheek, discoloring a large portion of that side

of the face. Crepitus can easily be elicited but the final exact diagnosis is best made by the x-ray.

Complications.—Complications of fracture of the maxilla are infection, septicemia, pyemia, meningitis, or caries. Blood loss may be alarming and injury to the infra-orbital nerve will cause paresthesiæ and neuralgic pains. At times there is paralysis of the palate. The nasolacrimal duct may be obliterated and epiphora result.

Fractures of the Inferior Maxilla

Etiology.—Fractures of the lower jaw are more common than in any other bone of the face, because of its exposed position and mobility. They are usually due to direct violence such as blows inflicted by the fist, kick, club, gunshot wounds, or falls on the chin. Occasionally an indirect violence is the cause, encountered as a compression of the bone inward from each side, often occurring in a squeeze against a wall. Such an injury usually causes a fracture near the symphysis and may be associated with a fracture of the skull. By a fall upon the chin the condyles are often fractured by counterforce. With only slight force



FIG. 4.—FRACTURES OF JAW.

(a) Fracture, junction of body and ramus; (b) fracture of coronoid process; (c) fracture through symphysis.

the mandible may be broken after it has been the site of some pathologic process such as osteomalacia, rickets, cystic odontomata and dentigerous cysts, osteomyelitis and malignant tumors, especially carcinomata. The extraction of teeth, especially those impacted or unerupted, may cause a fracture of the alveolar process, usually partial; such an injury may also follow a direct blow on the teeth.

Mandibular fractures are unusual in childhood and old age, occurring usually in adult life, and ten times as frequently in men as in women, due to the more frequent exposure of men to the severe accidents.

Frequency of Site.—Those of the body are by far the most common, while the ramus, coronoid and condyloid processes are comparatively rarely broken. Fractures are usually single but may be bilateral. In order of frequency, the mandible is fractured in the region of the canine or incisor teeth, at the angle, the symphysis, the neck, at the alveolar process, the ramus and lastly at the coronoid process.

Mechanism of Displacement.—The mechanism of displacement is complicated because of the large number of muscles attached to the mandible. In a general way those fractures nearest the midline show the greatest displacement because of the downward pull of the depressors, the mylohyoid, digastric, geniohyoglossus and geniohyoid and the upper inward pull of the elevators, the masseter, temporal and internal pterygoid. If the fracture is bilateral, that is, through the region of the canine teeth on either side, the intervening fragment is pulled downward and backward.

In the region of the molar tooth or through the ramus, the fracture is usually unilateral with less tendency to deformity. If bilateral, the body of the bone is pulled laterally and upward. Simple or subperiosteal fractures do not give as marked displacement as compound ones. For all these fractures the resulting displacement depends upon the relation of the point of separation to the attachment and tension of the elevator and depressor muscles, on the obliquity of the fracture lines and its extent, on the amount of soft tissue injured, and on the force and direction of the violence.

Examination.—Examination for fracture of the lower jaw will usually require only inspection because of the obvious deformity. The alignment of the teeth should be studied and any displacement of one side or of a few teeth, noted. Swelling and lacerations of the gums or mucous membranes with hemorrhage are important signs to look for. The mandible should be palpated for deformity and tenderness. By grasping the bone between the thumb and index finger of each hand placed on either side of the site of suspected fracture, abnormal mobility and crepitus should be sought. Finally an x-ray picture will give the exact diagnosis.

Symptomatology.—The signs and symptoms of a fracture of the mandible will depend upon the site of injury. In a general way there is pain in the jaw with tenderness over the point of fracture, visible deformity, mobility, and crepitus. The motions of the jaw, as in opening the mouth and eating, are consciously limited because of the resulting pain. Swallowing is difficult. Lacerations of the mucous membranes of the mouth with resulting hemorrhage are the rule, and if the fracture is within the area of the teeth, there is loss of the normal alignment of the teeth. There may be a sensation of the teeth feeling loose and the patient is aware of actual abnormal motion of certain teeth. Saliva is copious, while on the adjacent side there is an asymmetry and a drooping of the mouth. Swelling over the affected parts occurs early. Numbness of the lower lip and chin is present if the inferior dental nerve has been lacerated or compressed.

If the fracture is at or near the angle of the jaw, the ramus is slightly depressed upward and forward by the pull of the masseter and internal pterygoid muscles. The body is depressed downward and backward. Because the fragment is short and imbedded in muscles it cannot be palpated easily. There is a thickening of the muscles below the zygoma with an irregularity of the jaw contour and swelling over the point of fracture. Pain and tenderness are present, especially when pressure is exerted laterally. There is inability to move the jaw normally so that an imperfect bite is made.

Fractures through the molar region are often complicated by injury to the inferior dental artery and especially the nerve, causing severe pain and anesthesia in the lower lip and chin. There is little displacement of the fragments.

Horizontal fractures of the ramus are rare because of the protection of the muscles. They allow a downward displacement of the anterior fragment by the digastric, mylohyoid and geniohyoglossus, and geniohyoid muscles. The posterior fragment is pulled upward and inward by the masseter and temporal muscles. There is a diminution in the arch of the lower jaw.

Fractures of the neck below the condyle make it impossible to palpate the condyle in front of the ear which, however, may be found as a movable mass in front of its normal position. There is an increase in the mobility of the jaw in the antero-

posterior direction, but a decrease in the vertical side. The neck of the condyle may or may not be rotated forward, depending on the relation of the point of fracture to the attachment of the external pterygoid. The back teeth may be closed when the front ones do not touch, causing a deranged bite. Pancoast mentions such a fracture in an aged man who was yawning.

Fractures of the neck of the condyle cause an abnormal depression just anterior to the glenoid fossa. Displacement is slight, but when present is always forward, due to the action of the external pterygoid.

Fractures of the coronoid process are usually rare, being caused by indirect violence alone. The fragment is drawn upward by the temporal muscle and can be diagnosed by palpation. Fractures of the superior maxilla or malar bone are usually associated with this injury.

Complications.—Complications of fracture of the lower jaw are hemorrhage, infection with abscess formation or osteomyelitis and non-union. If an anterior fragment is displaced sufficiently far backward, it may allow the tongue to drop, closing the glottis and causing asphyxia. A fracture through the mental foramen may compress or lacerate the inferior dental nerve, giving rise to troublesome neuralgic pains and anesthesia of the chin and lower lip.

Fractures of the Hyoid Bone

Etiology.—Fracture of the hyoid bone is usually due to severe direct violence, as in strangling, hanging, garrotting, and, rarely, in falls. Muscular action has been held responsible in a few cases.

Frequency of Site.—The fracture is most frequently encountered at the junction of the great cornu and the body; it may involve the body itself but is seldom bilateral.

Mechanism of Displacement.—To the hyoid are attached many muscles of the tongue and throat, such as the stylohyoid, geniohyoid, geniohyoglossus, mylohyoid, sternohyoid, omohyoid, thyrohyoid and hyoglossus to the body; thyrohyoid, middle constrictor, hyoglossus and digastric to the greater cornu and chondroglossus and middle constrictor to the lesser cornu. Therefore the importance of this bone and the symptoms following its fracture are readily understood. If the greater cornu is fractured it is usually bent inward by the middle constrictor.

Examination.—Examination for fracture of the hyoid should include inspection and palpation of the upper throat region. By grasping the cornu between the fingers of both hands, abnormal mobility may be discovered. A study should be made of the ability to move the tongue in different directions and the resulting pain, if any. It must be remembered that if the normal larynx is moved by the thumb and fingers over the cervical spine a click resembling crepitus is found; in case of an accident this might be taken for fracture.

Symptomatology.—When the hyoid bone is fractured, there is sharp pain in the upper throat increased by moving the tongue, as in speaking or swallowing, or in opening the mouth. There are signs of external bruising, as contusion and ecchymoses about the neck. The pain and accompanying tenderness are accentuated by pressure. Swelling follows soon after the injury, with difficulty in swallowing and usually great dyspnea. Sometimes blood escapes from the mouth. There may

be paroxysms of suffocation when the tongue is depressed, a distressing cough, and hoarse voice. Abnormal mobility of the cornu may be palpated.

Complication.—Complications are severe hemorrhage from perforation of the branches of the lingual artery by the bone, puncture of the pharynx, abscess and edema of the glottis.

Fractures of the Thyroid Cartilage

Etiology.—Fractures of the thyroid cartilage are caused by severe pressure as in blows, falls, strangling, and hanging. The *cricoid cartilage* may be fractured at the same time or separately, although this is much rarer—about eight to one. All these injuries are uncommon. The fracture occurs by lateral compression on both sides or pressure backward toward the vertebræ. Displacement is slight or entirely absent. Isolated fractures of the *tracheal rings* occur as the result of stab or gunshot wounds or attempts at suicidal hanging.

Examination.—Examination for all these fractures concerns chiefly palpation of the larynx and a careful study of the presenting signs and symptoms.

Symptomatology.—When any portion of the larynx is fractured, the results are similar to those found in injury to the hyoid bone. There is pain and tenderness over the point of separation, increased by speaking, swallowing, and deep breathing. Swallowing is usually more difficult and more painful than in hyoid fracture. Dyspnea and cyanosis are marked and distressing. Swelling appears early and edema of the glottis may occur. There is usually bloody expectoration and a convulsive cough. The voice is affected or even lost. Deformity is usually present, the Adam's apple appearing smaller or pushed out of the midline; but swelling soon obscures this sign. Abnormal mobility can usually be found by gently pressing the cartilages between the fingers. Emphysema of the subcutaneous tissues and intermuscular spaces is often present.

Complications.—Complications of fracture of the larynx are suffocation due to blocking of the air passage, hemorrhage, or edema. Infection with abscess or pneumonia may follow. Edema of the glottis is especially alarming.

Fractures of the Vertebræ

Etiology.—Fractures of the vertebræ are caused by direct violence, such as blows, crushes, falls, gunshot and stab wounds, and also by transmitted violence, as falls on the head, buttocks, and feet.

Frequency of Site.—Fractures of the spine are comparatively uncommon. They constitute less than 1 per cent of all fractures. The fifth and sixth cervical, the twelfth dorsal, and the first lumbar are the vertebræ most often injured. Approximately one-fourth of spinal fractures occur in the cervical region, and more than one-half of all cases in the lower dorsal and upper lumbar regions. Fracture-dislocation is most common in the cervical region; less so in the dorsal region, and exceptional in the lumbar spine. Compression fractures are most frequent in the lumbar region. Fractures of the spinous processes and neural arches predominate in the cervical region, but occur quite often in the dorsal spine.

Mechanism of Displacement.—The various agencies of direct violence are capable of fracturing any portion of the vertebræ, including the bodies. Indirect

violence affects, chiefly, the vertebral bodies, since transmitted force is the essential factor, this being conducted through the bodies in the same fashion as superincumbent weight. Arching or bowing of the spinal column is essential in these types. Thus, in a fall upon the vertex of the skull, the neck is acutely flexed, and the vertebra or vertebræ, at the incidence of the abnormal curves produced, are subjected to tremendous pressure. The result is a crushing fracture, with collapse of the body because of the cancellous nature of the bone. In similar manner, falls on the neck and shoulders, when the back is bowed, or a crushing force, exerted between the shoulders and buttocks, may produce fracture in the dorsal or lumbar region. Fracture is also a frequent complication of dislocation of the spinal column. The fixed portions of the spine—sacrum and coccyx—are usually injured by direct violence.

Simple and compound fractures occur; likewise, simple and multiple (comminuted) fractures.

Fractures of the processes and the neural arches may be isolated results of injury, or may occur in association with fractures of the body. Fractures of the articular processes have particular interest, because impingement of the bony fragments upon the cord is thereby permitted.

Fractures of the vertebral bodies are usually of the crushing type, although linear fractures occur rarely. As mentioned, they are often found in conjunction with primary dislocation. Under such conditions, and also when vertebral collapse is marked, as well as when fragments of the body are displaced, the spinal cord is very likely to be contused or compressed. Acute anterior flexion of the spine is the essential mechanism in the production of these fractures. The affected vertebra is subjected to pressure which collapses the body and alters its contour, transforming it into a wedge with its apex forward. This collapse may be so extensive that the superior and inferior margins of the body are in apposition. At times, a fragment of bone is displaced anteriorly or posteriorly, the latter causing injury of the spinal cord. Occasionally the vertebræ above the injured one are carried forward on it, thus distorting the cord, or even lacerating or dividing it. The wedge-shaped collapse, more evident in the anterior portion of the body, serves to displace the spinous process backward, where it appears as a kyphosis or knuckle, or where it acts to modify a normal curvature—as, in the lumbar region, more than one vertebra may be fractured simultaneously.

Injuries to the spinal cord and its membranes, to the intervertebral cartilaginous disks, and to the vertebral ligaments and paravertebral muscles are often associated with severe vertebral fractures.

Symptomatology.—Fractures of the spinous processes and the laminae are indicated by pain in the region affected, exaggerated by motion, and by tenderness upon pressure. In both types of fracture, displacement of the spinous process frequently happens. Such displacement may be either lateral or downward (vertical). Abnormal mobility and crepitus may also be detected. The usual findings in fracture of the transverse processes include pain, restricted mobility with muscular spasm, and pressure tenderness lateral to the spinous processes. It is not the rule to elicit crepitus.

Fracture of the body of a vertebra occasions symptoms which depend partly upon the bony injury and partly upon injury to the spinal cord. Linear fractures,

which are accompanied by little or no change in the contour of the vertebral body, give rise to no deformity, but are responsible for pain, muscular disability, and pressure tenderness. This triad of symptoms, subsequent to direct or indirect injury to the spine, always calls for radiographic investigation.

With true compression fractures, there is, as a rule, initial shock and oftentimes temporary unconsciousness. The patient is unable to move the injured part, and suffers agonizing pain upon passive motion, such as that necessary to transport him. With dorsal and lumbar fractures, he is commonly unable to arise, although no paralysis of the muscles exists. In the cervical region, the head is held in a stiff, forward-flexed attitude, to which rotation may be added because of associated dislocation. Severe local pain is complained of, and may be referred, together with paresthesiæ, to the extremities. In the dorsal and lumbar regions it may assume a girdling character, or it may be referred with greatest intensity to the abdomen.

Upon examination, the signs of injury may be noted. The normal cervical and lumbar concavities are sometimes decreased or obliterated; or one or more spinous processes may project posteriorly. This may be either the spine of the injured vertebra or that of the vertebra below (fracture-dislocation). Such deformities, however, are not constant since initial dislocation may have been spontaneously reduced, or the recumbent posture may have relieved, to a certain extent, either the dislocation or the compression of the vertebra; a constant finding, however, is extreme tenderness, when local pressure is made. Since it is injudicious to seek for abnormal mobility and crepitus, this should be sufficiently suspicious to call for detailed neurologic and x-ray findings. A fracture-dislocation in the cervical region can sometimes be palpated through the pharynx.

The spinal cord may be contused, compressed or completely crushed by the vertebræ, and is frequently involved by meningeal or intramedullary hemorrhage, and by secondary edema. In the later stages, ascending myelitis is a fairly common sequel. The symptoms of spinal cord injury vary with the anatomic site and also with the transverse extent of the lesion.

In fractures of the *cervical spine*, with cord injury, immediate death often results. This is particularly prone to occur when the fourth cervical segment, the origin of the phrenic nerve, is injured. With a complete transverse lesion of the cord in the cervical region, below this level, there is flaccid paralysis of both upper extremities and also of the accessory muscles of respiration. Breathing is therefore entirely diaphragmatic. At the same time there is an immediate flaccid paralysis of the lower extremities, as well. After an interval this assumes the spastic or rigid type, with increased tendon and Babinski reflexes. Priapism and involvement of the organic sphincters also develop. There is complete anesthesia almost to the level of the cord lesion, with a superior zone of hyperesthesia. The upper level of this zone corresponds with the site of injury. All gradations of sensory and motor alterations occur in incomplete lesions. They may exist in any or all of the extremities; may assume the form of hemiplegia or hemiparesis; or may involve only certain muscle groups, cutaneous surfaces and related tendon reflexes. Minor cord symptoms, such as pain, numbness, and tingling in the upper extremities or in the fingers alone, are possibly indicative of a fractured cervical spine, especially if there is local tenderness and any change in the attitude of the head.

An interesting phenomenon, when the cervical sympathetic fibers are involved in the eighth segment, is *Horner's syndrome*, which is characterized by miosis, enophthalmos, and narrowing of the palpebral fissure. Since they derive all, or the greater part, of their innervation from segments above the sixth cervical, the deltoid muscles, the external rotators of the shoulders, the flexors of the elbow, and the supinator muscles are intact in lesions at or below this segment. An attitude which brings these muscles into action is therefore very characteristic and indicative of the approximate level of the cord involvement.

In the dorsal region, complete lesions of the cord are common, because of the remarkable incidence of severe fracture-dislocations. When the first dorsal segment is thus affected, in addition to a paralysis of the intercostal and abdominal muscles and immediate flaccid paralysis of the lower extremities, loss of function of the intrinsic muscles of the hands and of the extensors of the thumbs is to be noted. Loss of sensations and disturbance of the organic reflexes also occur, as in cervical cord injuries. These sphincter disturbances in both regions consist of constipation and overdistention of the bladder. At lower dorsal levels, down to that of the tenth dorsal vertebra, the symptomatology is similar, excepting for alterations in the smaller muscles of the hand and thumbs.

The lumbar enlargement of the spinal cord extends from the eleventh dorsal to the lower border of the first lumbar vertebra, where the cord terminates. Below this point is the cauda equina, the nerves of which course downward through the spinal canal, which they leave at various inferior levels. Fractures involving the lower two dorsal and the first lumbar vertebrae, and causing damage to the cord, are best considered together in respect to neurologic findings.

A complete transverse lesion in this locality produces flaccid paralysis of the entire lower extremities, with a loss of tendon and cutaneous reflexes, and sensory and motor disturbances of the rectum, bladder, and sexual functions, causing incontinence of the sphincters. All forms of sensation are completely lost up to the level of the injury. The symptomatology depends upon the exact site of injury, however, and definite rules cannot be established. Also, the cauda equina is being formed here, and some of its nerves may escape, as they are more resistant than the cord itself. If the last dorsal nerve escapes, the upper limit of anesthesia does not coincide with that of the injury, and lack of involvement of the ilio-inguinal, genito-femoral, and iliohypogastric nerves further minimizes the extent of sensory loss and abdominal muscle paralysis. Tympanites usually occurs with lesions at this level.

With incomplete cord injuries, the sensory, reflex, and muscular alterations are modified, and the area of sensory loss is obliquely rather than horizontally limited. Pain and paresthesia, muscular rigidity and twitchings, and preservation or exaggeration of the reflexes are also to be observed, unless the reflex areas have been traumatized.

Below the first lumbar vertebra, the cauda equina is injured. Traumatic affections of the cauda are very frequently incomplete, accounting for unilateral, as well as bilateral, functional changes and for partial losses of muscular, sensory, and reflex functions. Below the fourth lumbar segment, cord injury does not abolish the quadriceps tendon reflex.

Injury to the conus medullaris alone involves the sphincters of the rectum and

urinary bladder, and produces anesthesia of the external genitals, the perineum, a small skin area about the anus and the posterior and superior two-thirds of the thigh surfaces. The anal skin reflex is lost. Observation of its loss absolutely localizes the lesion.

Fractures of the sacrum may give rise to visible and palpable deformity and the other signs of fracture. This is to be considered as exceptional, however. Pain, localized or referred, avoidance of voluntary motions and pressure tenderness over the sacrum are much more common than the classical signs and are fully as significant.

Fractures of the coccyx are extremely painful, as a rule. Difficulty in assuming the sitting position is characteristic. Pain in the rectum and interference with evacuation of the bowels are significant. Tenderness, deformity, abnormal mobility, and crepitus are to be determined by combined external and rectal palpation. Coccygodynia often persists for long periods, even years, after fracture of the coccyx.

Trophic disturbances, important sequelæ of cord injury, usually appear within a few days. They comprise edema, muscular atrophy, bed-sores, and trophic ulcerations. The latter are frequently infected, leading to death. Neuropathic arthropathies are also seen, particularly in a complete crushing of the cord. Contractures are a common result, from paralysis of muscle groups and overaction of their antagonists.

Complications.—In addition to trophic disturbances, infection of the urinary tract, subsequent to repeated catheterization, is to be reckoned with. This is a frequent cause of death. Hypostatic pneumonia is another prevalent complication, particularly in cervical injuries. In a high cervical fracture-dislocation, sudden death occurs at times from unskilled manipulations by the examiner and from attempts at reduction. Complications in respect to the cord itself include infection in compound fractures through the surface wound; ascending myelitis and hematomyelia. The last named may extend for some distance above and below the primary level of the cord injury. The fractured vertebræ themselves may be invaded by organisms from without, which gain access through wounds and, occasionally, are infected from within by way of the blood stream. A late sequel, especially apt to occur in untreated cases, is traumatic spondylitis.

Radiography.—Pictures in two planes are essential. With proper technic, radiography in spine fractures is highly efficient. Films of the upper cervical vertebræ are best taken with the patient's mouth wide open. Some difficulty will be experienced in certain linear fractures of the sacrum and, also, in fractures of the vertebral bodies with slight collapse. We have repeatedly noted that the body of the fifth cervical vertebra is normally smaller than its neighbors in many individuals. Interpretations should always be made by an expert radiographer.

Diagnostic Summary.—In cases of direct and indirect trauma to the spine, radiographs must be taken. Suspicion of spinal injury arises whenever pain is complained of. The pain is usually in the spine but may be referred laterally or into the related extremities. Paresthesiæ in the extremities are equally significant. The external signs of injury are often visible, and the classical signs of fracture may be obtained by palpation. This is particularly true in fractures of the spinous processes and the neural arches. Unusual care in palpation is enjoined in all suspected body fractures. Localized tenderness, using moderate pressure, directs one's

attention to the probability of fracture and, with modern x-ray facilities, it is certainly unwise to seek for crepitus and mobility.

A spinous process apparently displaced in either plane is of the greatest diagnostic moment. Obliteration of normal contour, as in the cervical and lumbar curves, is of almost the same import. Departures from the normal attitudes of the head and trunk must always inculcate suspicion of spinal fracture.

In fractures of the vertebræ with involvement of the spinal cord, the resulting paralysis is usually immediate. An exception to the rule, in a few cases of delayed paralysis, is explainable by further cord compression from displaced fragments, or by delayed hemorrhage into the cord. Bleeding from the vessels of the surrounding membranes is comparatively rare as the source of compression. In complete transverse crushing and division of the cord at any level, the resulting motor paralysis is of the flaccid, atonic type and is accompanied by loss of tendon reflexes. Simultaneously, the corresponding skin reflexes are abolished and there is total anesthesia. That is, the anesthesia embraces tactile, pain, temperature, and muscular sensibilities, the latter including, of course, position sense. The upper limit of anesthesia, with or without a superior zone of hyperesthesia, usually is opposite the cord segment affected. The Babinski reflex is often present in lesions of the cord at various levels. Priapism, obstinate constipation, and overdistention of the bladder with dribbling occur with cervical and dorsal cord lesions. Low dorsal and upper lumbar injuries usually cause distention of the intestines, paralysis of the organic sphincters, and flaccid paralysis of the muscles of the abdomen and lower extremities.

Differentiation between compression of the cord and complete crushing or division is to be made. If the injured person has any form of sensation or any motion below the level of injury, the lesion should be considered incomplete. This rule may be interpreted as including the sensations of full bladder and rectum. Regarding the muscular involvement, paraplegia is the rule. Incomplete injuries, however, particularly those due to missiles and penetrating objects, may produce hemiplegia, monoplegia, or partial paraplegia. With this type of injury, the Brown-Sequard syndrome may be present. Spasticity, muscular resistance and twitchings, severe pain and paresthesia are much more common in incomplete lesions. Injuries to the cauda equina are frequently incomplete, and the prospects of future improvement are best in such cases. Some of the objective losses in apparently complete division of the cord may be due to hematomyelia. Contrarily, an apparently incomplete lesion at the onset may later become complete because of edema and degeneration of the cord elements.

Since the voluntary muscles and the cutaneous surfaces have segmented representation, modifications of their functions and sensibilities imply interruption of function at such segments of the cord as coincide with the particular findings. These segments do not correspond numerically with the surrounding vertebræ, since the cord terminates at the inferior border of the first lumbar vertebra. The muscular, reflex, and cutaneous functions are thoroughly tested and classified and, knowing the spinal origin of the nerves involved, the segments affected can be determined. In the greater part of the cervical region, as well as in the dorsal and lumbar segments, the extent and distribution of paralysis and anesthesia are most

important in deductions. In the lower cervical and upper dorsal, the muscles and cutaneous areas which remain intact are more significant in localization. This is also true of many lesions of the cauda equina. Intact reflexes in the presence of other disturbances are also of considerable value.

A simple method of relating segments to vertebræ is that of Chipault. By this method, in the cervical region add one to the number of the vertebra to give the segment opposite its spinous process; in the upper dorsal, add two; from the sixth to the eleventh dorsal, add three. The lower part of the eleventh dorsal spine and the space below it are opposite the lower three lumbar segments. The twelfth dorsal spine and the space below are opposite the sacral segments. (Quoted in *Keen's Surgery*, Vol. II, p. 842.)

The following table of the more common segmental relationship of various reflexes is also of value:

Tendon Reflexes

Triceps.....5 and 6 cervical
 Bicipital.....5 and 6 cervical
 Radial.....5 and 6 cervical
 Knee-jerk.....2 and 4 lumbar
 Achilles tendon.... 5 lumbar, 1 sacrum

Cutaneous Reflexes

Interscapular....5 cervical to 1 dorsal
 Epigastric7 to 9 dorsal
 Umbilical.....8 to 12 dorsal
 Cremasteric.....1 and 2 lumbar
 Gluteal.....4 and 5 lumbar
 Plantar..... 1 and 2 sacral
 Babinski in lesions of pyramidal tract
 Anal.....conus medullaris

Fractures of the Clavicle

Etiology.—Fractures of the clavicle are of common occurrence due to its exposed position, and to its being the only osseous connection between the upper extremity and the trunk; it therefore receives the full force of a blow, transmitted from the arm to the body. Fractures of a “greenstick” nature are commonly found in early life, and often follow trifling injuries while the complete fracture represents the adult type. They are rarely compound.

Direct and indirect violence and muscular exertion are the causative agents. Indirect violence is most common. A recent case of bilateral fracture of the clavicle occurring on our service was caused by a horse crowding the patient, laterally, against the side of the stall.

Frequency of Site.—Three types are recognized and in order of their frequency are as follows: (1) Middle, (2) outer, and (3) inner thirds.

Mechanism of Displacement.—The muscles involved are the sternocleidomastoid, trapezius, deltoid, subclavius, pectoralis major, and pectoralis minor.

Fractures of the middle third are the ones most frequently encountered; this is due to the slenderness of the bone in this area, the change in the direction of the clavicular curve, and to the scarcity of muscular attachments in this location.

The displacement of the fragments is dependent upon the security of the inner fragment attachment which is almost fixed by the sternocleidomastoid muscle, on its superior, and the costoclavicular ligament, the subclavius and the pectoralis major on its inferior aspect. This combination of muscles and ligaments holds it in a normal position or allows only of a very slight upward displacement. The

outer fragment, on the other hand, is pulled downward and inward by the weight of the shoulder and arm, the deltoid and fibers of the pectoralis major, overcoming the weaker upward pull of the trapezius. Since the outer edge of the fracture usually glides behind the inner, the scapula is so rotated that the anterior edge is forced inward and the posterior edge, outward; the shoulder falls forward, inward, and downward.

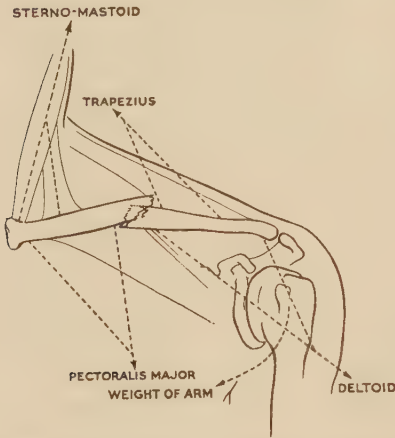


FIG. 5.—FRACTURE OF MIDDLE THIRD OF CLAVICLE.

affords opportunity for fractures to occur in this location. The inner fragment is displaced slightly upward because of the attachment of the sternocleidomastoid muscle, which is somewhat offset by the costoclavicular ligament. The inner end of the outer fragment is displaced downward by the pectoralis major and deltoid muscles which overcome the weaker upward pull of the trapezius.

Examination.—If possible have the patient in a sitting or standing position (preferably the former) with as much relaxation as is possible. Note attitude. Always compare both clavicles and shoulders. Observe the deformity, if it is present; clavicular curves, bony prominences, as may appear on the injured side and as compared with its fellow on the opposite side; swelling and discoloration of the skin, visible differences as may appear in the length of both clavicles. Expansile pulsation. Presence of paralysis or paresis in the arm on the side of the suspected injury, together with signs of circulatory disturbance.

Palpation should be carried out in the most careful manner, disturbing the fragments as little as possible from the position as one finds them. With the tips of the fingers gently palpate along the whole bone and its neighboring structures. Locate exactly the position of the coracoid process (found a finger's breadth below the clavicle and along the inner margin of shoulder). All movements of shoulder joint both on

Fracture of Outer Third.—Displacement varies. In some cases it is slight while in others (outer inch of bone, external to trapezoid ligament) the outer fragment forms almost, or completely, a right angle with the inner; the apex of the angle being directed backward. The anteroposterior deformity is usually marked and pathognomonic, the outer fragment being bent sharply inward at the point of fracture. The weight of the arm carries the outer fragment downward and inward. When the fracture is between the conoid and trapezoid ligaments, there may be no displacement.

Fracture of Inner Third.—Though most infrequent of all the clavicular fractures, the dense non-yielding costoclavicular ligament af-

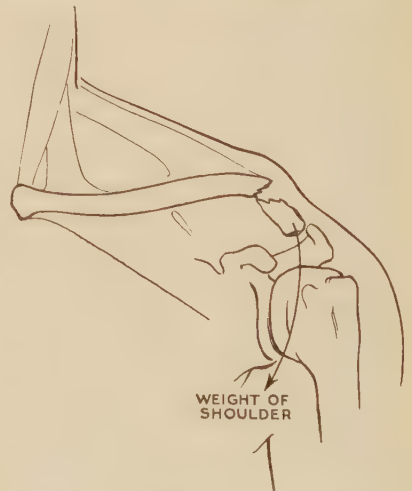


FIG. 6.—FRACTURE OF OUTER THIRD OF CLAVICLE.

normal and affected side should be gently performed and they should include as thoroughly as is possible the motions of abduction, adduction, rotation, and the moving of the arm forward and backward. Limitation of any of these movements together with observance of pain in any one or all of them should be observed. Crepitus if detected should be recorded. (Never use undue force to determine this sign.)

Measurements are of the utmost importance and should be taken in all cases. The anatomic landmarks for the measurement of clavicular injuries are (1) the midportion of episternal notch, (2) outermost prominent margin of the greater tuberosity (outer border of shoulder). A tape or preferably calipers can accurately determine any existing differences between the two sides. The anatomic landmarks for the measuring of the humeral shaft are (1) the edge of the acromial process, (2) external condyle of the humerus. (Elbow flexed to right angle and against body.) The distance as determined by the tape will accurately determine any difference in the humeral shaft length between the two sides.

Symptomatology.—The “greenstick” or incomplete fracture of the clavicle so commonly found in early life will, as a rule, give rise to less deformity than that found in the complete type. The history of the accident may aid in the diagnosis and the *attitude*, assumed by the patient is, at times, almost pathognomonic; *i.e.*, the inclination of the head to the affected side and the supporting of the elbow and forearm on the same side, held by the hand of the uninjured side. In addition to these signs are generally noted a swelling over the site of the fracture, impaired motion of the arm and shoulder, on injured side, discoloration (at times) over fractured area, pain on pressure and on attempted motion of the arm, over the injured part. As a rule, measurements will show no shortening nor will there be present “shoulder depression.”

A complete fracture of the clavicle is usually found in the adult. The signs and symptoms vary to a certain extent with the location of the fracture, but in a general way all patients who have a complete fracture of the clavicle present a certain number of signs and symptoms which are more or less characteristic of the condition. They are as follows: The inclination of the head to the affected side and the supporting of the elbow and forearm on the same side held by the hand of the uninjured side. The shoulder upon the affected side is depressed, which as a rule does not appear in cases of “greenstick” fracture. A protuberance is usually noted over some portion of the clavicle.

In fractures of the middle third a bony deformity is usually noted, the outer fragment being pulled somewhat downward, the shoulder forward and inward, while the inner fragment assumes a stationary or a slightly elevated appearance. Very often there is a definite spicule of bone detected just beneath the skin which

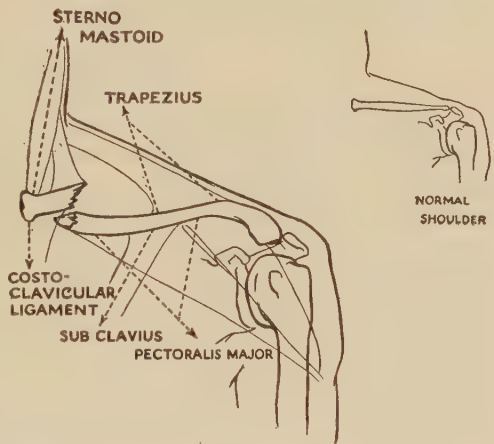


FIG. 7.—FRACTURE OF INNER THIRD OF CLAVICLE.

usually corresponds to the outer portion of the inner fragment. The outer edge of the fragment is usually behind the inner. Impaired motion of the arm and shoulder is very apparent, discoloration and swelling over the affected area are frequent and there is usually a *shortening* of the distance between the episternal notch and the outer border of the shoulder. Crepitus may or may not be elicited.

In fractures of the outer third, there may be no displacement of the fragments though when deformity does occur, it is of an angular type, the apex being directed backward. When the fracture is at the outer inch of the bone the outer fragment is usually turned forward and inward. In this location a marked drooping of the shoulder downward and inward is noted.

The fractures of the inner third usually show a slight deformity just lateral to the inner edge of the clavicle due to a slight tilting of the inner fragment upward.

Complications.—Possible injury to the important vessels of the upper arm and shoulder and to the nerve cords of the brachial plexus, lung injury and non-union.

Fractures of the Sternum

Etiology.—Fractures of the sternum are caused by direct or indirect force; the former is received as a severe blow, as falling from a height or having a wheel or heavy object pass across the chest, the latter by muscular action or forcible hyperextension or hyperflexion of the upper portion of the trunk. The chin may be driven against the sternum if the flexion is severe enough. The fracture may occur as a *contrecoup* in falls on the back or side and is often associated with fractures of the ribs and vertebræ. This injury has been reported during straining at childbirth, and by lifting heavy objects, especially with the teeth, the body bent far back. Direct force is the most common cause of this condition.

Frequency of Site.—All fractures of the sternum are rare, the ribs usually giving way before the sternum breaks. Fractures of the spine or even dislocation of the sternum or ribs are more common. When a sternal fracture does occur it is usually in the upper half and especially near the junction of the manubrium and gladiolus. A dislocation at this point is sometimes described as a fracture. The line of fracture is usually transverse and complete, and is very rare below the level of the third rib.

Mechanism of Displacement.—The deformity produced is the result of compression of the thorax and an attempt to lessen the natural curves and force the bony framework to occupy a smaller space.

Measurements.—There is often shortening of the sternum with, as a rule, anterior displacement of the lower fragment.

Examination.—Examination for fracture of the sternum usually requires only inspection because of the deformity. In severe injuries involving the spine or ribs, the sternum should be inspected and carefully palpated for tender points and deformity. It should rarely be necessary to use force and inflict upon the patient the pain resulting, in the determination of crepitus and abnormal mobility.

Symptomatology.—Over the sternum at the site of fracture is pain, increased by pressure, change in position, or forced inspiration or expiration. The deformity is usually clearly visible, so that the determination of abnormal mobility and crepitation are seldom necessary. Ecchymosis may be present at the point of separation;

a compound fracture is extremely rare. The patient may have felt the separation of the bone at the time of the injury and he may be able to point to the exact point of fracture. A semirecumbent or sitting position, with a bending forward of the head and shoulders and avoidance of any motion that tends to straighten the trunk, is a quite characteristic *attitude* assumed by the patient. If an hematoma has formed within the anterior mediastinum, increased dulness on percussion may be noted there, but it is doubtful if such an examination could be endured.

Complications.—Fractures of the sternum may be complicated by rupture of the pleura, lung, pericardium or heart, hemothorax, laceration of the internal mammary artery or vein and, rarely, thrombosis of the same vessels. An abscess may develop and non-union has been known to have occurred.

Fractures of the Ribs and Costal Cartilages

Etiology.—Fractures of the ribs and costal cartilages are due to the same causes and give the same symptoms, so that they will be discussed under one heading. Injuries of these bones occur most frequently in adults and elderly people. In childhood they are rare because of the elasticity of the bone tissue. Such fractures are due almost always to direct violence, such as receiving a heavy blow against the chest wall. At times, the cause may be indirect violence, as a wheel rolling over the chest, and very rarely it is due to severe muscular strain in coughing or sneezing.

Frequency of Site.—The site most frequently fractured is the point directly beneath the blow. At other times the fracture is sustained at the weakest point of the rib, that is, just in front of the angle and again near the junction of the anterior cartilage with the bone itself. The first and second ribs are protected by the clavicle so that they are not frequently fractured. The eighth, ninth, and tenth ribs are connected anteriorly only, by the costal cartilages, and the eleventh and twelfth have no anterior attachment so that these five are less liable to fracture. Therefore, the fourth, fifth, sixth, and seventh ribs are those most frequently injured.

The fracture may be transverse, oblique, irregular, comminuted, very rarely compound and either unilateral or bilateral. Because of the attachment of the intercostal muscles there is no shortening or vertical displacement of the chest wall.

Examination.—For the determination of rib fractures, the entire chest should be inspected. The patient may complain of a tender spot directly over the broken rib and this area as well as the entire surface of the chest should be systematically palpated for tenderness. The thorax should be compressed between the hands antero-posteriorly and laterally to elicit pain. By palpation crepitus may be felt and at times crepitus may be heard with the stethoscope placed over the site of fracture.

Symptomatology.—With a partial incomplete fracture there may be no symptoms. In the usual case there is some embarrassment of respiration, with pain over the point of fracture on deep inspiration, sneezing, or coughing. There may be a slight non-productive cough and, at times, some blood-tinged sputum. The *attitude* and movements made by the patient are such as to guard against further irritation to the broken bones. There will be displacement only, if several ribs are broken. Crepitus may be felt by the patient himself when moving or coughing and he can point out the exact line of fracture. At other times, crepitus may be discovered by

the examiner with the palm of the hand flat on the chest wall, this being made more definite with the aid of the stethoscope.

Complications.—Fractures of the ribs may be complicated by injury to the pleura or lung, made manifest by coughing, blood-tinged sputum, and pneumonia. Air escaping beneath the skin may give rise to severe emphysema which may extend to the neck and face and occasionally over the whole body. Pneumothorax is a rare complication, as is injury to the pericardium, heart, or intercostal blood-vessels. A dry pleurisy localized at the site of fracture is fairly frequent. If the rib protrudes through the skin, infection and osteomyelitis may follow.

Fractures of the Scapula

Etiology.—Fractures of the scapula are uncommon. They usually follow some direct and great violence. Cases have been reported in which indirect violence and muscular exertion have occasioned fractures of the coracoid process.

Frequency of Site.—Body, neck, acromial process and coracoid process.

Mechanism of Displacement.—In fractures of the *body*, there may or may not be displacement. As a rule in fractures below the spine, the inferior fragment is pulled forward or forward and upward by the action of the serratus magnus anticus and of the teres major muscles, while the superior fragment has a tendency toward falling backward and then upward, being drawn by the action of the rhomboideus muscle.

In fractures of the *surgical neck*, the vertical lowering of the glenoid fragment depends upon injury to the acromioclavicular and coracoclavicular ligaments and upon the extent of the damage to the overlying and underlying muscles and periosteum.

In fractures of the *acromial process*, when the periosteum is intact and there has been no especial injury to it, there is no displacement; if, on the other hand, the surfaces have been much disturbed, the acromial process is drawn downward by the action of the deltoid muscle and the weight of the arm. In fractures of the *coracoid process*, the process is, as a rule, carried downward by the combined action of the short head of the biceps, the pectoralis major and coracobrachialis muscles. (This only follows, provided there has been a rupture or serious damage to the coracoclavicular ligament.)

Examination.—Place the patient in such a position that the examiner may readily compare both scapulae by inspection and palpation; the erect position is preferred. The patient should be instructed to elevate his shoulders in such a manner as to raise the scapular margins, making them as conspicuous as is possible. In examining for the presence of a possible fracture of the scapula below the spine, the forearm should be laid across the back. The examiner should palpate along the crest and over all parts of the scapula palpable; when examining the posterior

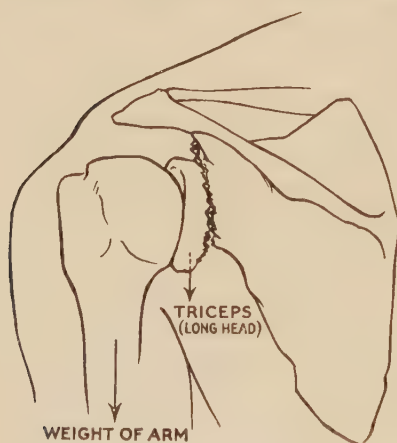


FIG. 8.—FRACTURE OF SURGICAL NECK OF SCAPULA.

(The upper arm appears to be lengthened.)

angle, the hand of the injured side should if possible be placed on the opposite shoulder, the forearm being carried across the front of the chest. All retardations in active and passive motions should be recorded, as well as any especial painful point or points. In determining the presence of crepitus, the palm of the hand may be placed over some portion of the scapula, steadying the fragment upon which it rests and moving the arm in all directions.

Measurements are of no value.

Symptomatology.—*The Body.*—At times, the swelling will be of so acute and extensive a nature as to rule out any possibility of determining the clinical signs of fracture. As a rule, however, pain on adducting and abducting the arm, local swelling and tenderness, and abnormal mobility will be present. Impossibility or great difficulty in raising the arm to the head is an important sign. Crepitus is generally present.

The Neck.—There is absolute uselessness of the arm which is, as a rule, held in a position of slight internal rotation upon the thorax. The head of the humerus is projected into the deltopectoral groove. The acromial process becomes prominent and there is noted a depression under the process. The upper arm appears to be lengthened. Passive motion of the arm is possible and upon lifting it up with the elbow flexed the deformity is corrected and crepitus may then be detected. There is a return of the deformity, if the arm is again lowered. Swelling and discoloration over the affected area may be present and painful points are as a rule elicited in the axilla, at the inferior glenoid tubercle and behind, along a line extending from the axilla to the middle of the vertebral edge of the scapula. (Bizard, *Gaz. d. Prat.*, Dec. 15, 1924.) The condition resembles, in many respects, an anterior dislocation of the shoulder; but it is differentiated from that lesion by the possibility of passive motion, the shallowness of the depression under the acromial process and the determination of the coracoid process moving with the humerus instead of with the scapula.

The Acromial Process.—According to Hamilton a separation of the epiphysis is more common than a real fracture, in this location. When there is no displacement, the diagnosis may be difficult and at times impossible. Generally there is localized pain and swelling over the affected area; a pronounced flattening of the shoulder is usually recognized by the examining finger as it passes along the spine of the scapula to its outer end. The head of the humerus falls into the glenoid cavity and crepitation is, at times, present.

The Coracoid Process.—This is an extremely rare condition. A dislocation of the outer third of the clavicle almost always accompanies a fracture of the coracoid process. Crepitus and probably a furrow or depression will always be noted in this condition. Other signs and symptoms, pathognomonic of a dislocation of the outer third of the clavicle, will be present.

Complications.—Paralysis of the arm due to pressure upon the brachial plexus, rupture of the axillary vessels, and fractures and dislocations of other neighboring bones may occur.

Fractures of the Humerus

Etiology.—Fractures of the humerus are of common occurrence and are due to direct or indirect violence. The former are received from blows, falls, crushings,

severe twistings, or gunshot wounds, while the latter may be due to dislocations, muscle pull, or a fall upon the hand or elbow. As a general rule, these fractures are more common in advanced age, although many are seen in adults exposed to severe industrial accidents. In childhood, separation of the epiphysis is the usual result. The fracture may be transverse, oblique, spiral, longitudinal or fissured, incomplete or greenstick, comminuted, impacted, simple or compound, with or without displacement and with or without dislocation of the neighboring joints. In short, practically any type of fracture may be found in the humerus.

Frequency of Site.—The most common fractures of the humerus are those of the surgical neck, the shaft just distal to the insertion of the deltoid muscle, the greater tuberosity, separation of the upper and lower epiphysis and of the external condyle. Scudder states that the fracture of the anatomical neck is “far more common than is generally supposed, particularly in middle-aged and elderly people.” This is not, however, the general idea regarding the frequency of fractures in this location. Supracondylar fractures are far from uncommon, while fractures of the external and internal epicondyles, capitellum, and trochlea are of great rarity.

Fractures of the Humerus

Upper end	{	head
		greater tuberosity
		anatomical neck
		surgical neck
		lesser tuberosity
Shaft (from insertion of pectoralis major to supracondylar region)	{	upper third
		middle third
		lower third
Lower end	{	supracondylar region
		intercondylar region { T-fracture
		{ diacondylar fracture
		external condyle
		external epicondyle
		internal condyle
		internal epicondyle
		capitellum
	{	trochlea
		lower epiphysis

UPPER END

Examination.—An examination of the shoulder should be carried out with a routine method, being mindful of the following points: It is better to have the patient stripped to the waist than to have him only partially exposed. If severely hurt or suffering much pain, the diagnosis may be made without disturbing the patient too much. The injured shoulder should be compared with the normal one, both by inspection and palpation. The diagnosis will be more easily accomplished soon after the accident, before swelling is too marked. The injured shoulder often shows a characteristic deformity, especially if the fracture is through the surgical

neck or upper portion of the shaft with resulting displacement. The bony points of the shoulder itself are in normal relation but just below, there is an angulation in the humerus over the site of fracture. The extremity should be palpated for deformity and tender points. An attempt at active motion of the arm will aid in locating the lesion after which passive motion should be tried. The examiner may manipulate the arm by himself or, while he holds the upper portion in as near a fixed position as possible, an assistant may rotate and move the elbow. This will disclose abnormal mobility and crepitus. Finally an x-ray picture should be made to give the exact location, type, and extent of the fracture.

Head of the Humerus.—*Etiology.*—As isolated fractures, fractures of the head of the humerus are extremely rare and are usually due to falls on the hand or elbow, the head being driven against the glenoid fossa. They are practically always found accompanying other fractures of the shoulder region or dislocations of the humerus. A fracture line through the anatomical neck will often have prolongations into the head, which may be severely comminuted, the fragments being impacted or displaced.

Examination.—An examination for fracture of the head of the humerus should include inspection for the presence of contusion, swelling, and deformity, followed by palpation for deformity and tenderness. The head can best be palpated through the relaxed axilla, with one hand, and from the anterior surface of the shoulder with the other. Active and passive movements are then to be attempted, the range of motion and resulting pain being carefully noted. It is usually impossible to make an exact diagnosis, especially if the fragments are impacted. But suspicion should be followed, in every case, by radiographs, which will show the exact type and extent of the injury.

Symptomatology.—The symptoms and signs of humeral head fracture will depend upon the extent of the separation. The diagnostic points will mimic severe sprain, subdeltoid bursitis, and fracture of the anatomical neck. If the breach is a simple fissure without displacement, symptoms will be very slight. Even with more severe fractures of the head of the humerus it may be impossible to find visible or palpable deformity, swelling, or abnormal mobility. Pain is usually rather severe and tenderness exquisite when palpating the head of the bone. In many cases there is moderate swelling of the shoulder, slight deformity, abnormal mobility, and crepitus. Active and passive motions of the arm will be limited because of the resulting pain. If the fracture line is an extension from other parts of the upper extremity of the humerus, the signs and symptoms will be added to those of fracture of the region involved. If, as frequently happens, the fracture is a complication of humeral dislocation the signs and symptoms of the former will be overshadowed by the latter.

Complications.—These are fractures at other points of the shoulder, accompanying dislocation, non-union, arthritis, and excessive intra-articular callus.

Greater Tuberosity.—*Etiology.*—Fractures of the greater tuberosity are caused by direct violence as a blow or fall upon the shoulder or, indirectly, by a fall with the upper arm in extreme abduction. They may or may not accompany anterior dislocation of the humerus, very rarely posterior dislocation. The injury is more common in adults, and is about six times more frequent in men than in women. This fracture is fairly frequently encountered.

Mechanism of Displacement.—The separation may be complete with wide displacement of the tuberosity, or it may be incomplete, being held by a few fibers of the periosteum to the shaft. The bony prominence may be torn away, fractured transversely or only a small portion of its cortex separated. The greater tuberosity is pulled upward and outward by the supraspinatus, infraspinatus, and teres minor. This pull is strong if the head of the humerus is dislocated downward and anteriorly to the subglenoid, or subcoracoid position. The muscles are put on such a stretch that their small area of attachment is wrenched loose rather than the muscle itself torn. The pull may be so great that the bony fragment is pulled upward until it lies between the acromion and head of the humerus. Due to the loss of function of the supraspinatus and infraspinatus and teres minor muscles, external rotation and abduction are impossible, but internal rotation is increased because the subscapularis has lost its antagonists.

Examination will be similar to that used in diagnosing other fractures of the upper ends of the humerus. Special care should be given in observing the active external rotation and abduction movements of the injured shoulder. An x-ray picture is to be taken in every suspicious case.

Measurements are of no value, there being neither increase nor decrease in the length of the arm.

Symptomatology.—Signs and symptoms of fracture of the greater tuberosity will include those generally found in severe shoulder injury, such as swelling, contusion, pain, and limitation of motion. The swelling appears within a few hours, may or may not be marked, but usually is greatest in an anteroposterior diameter. There are frequently present on the shoulder evidences

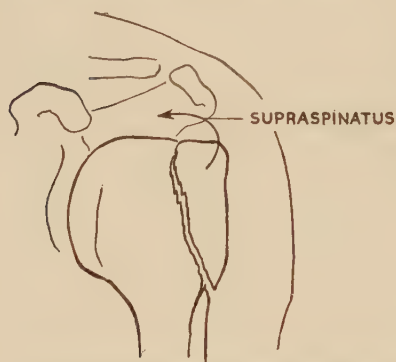


FIG. 9.—FRACTURE OF THE GREATER TUBEROSITY OF HUMERUS.

of injury, as contusion and ecchymosis. Pain in the shoulder region may be severe and increased by motion of the arm. Deformity is absent; there is no flattening of the shoulder. In some cases a slight depression has been noted under the acromial process and there may be prominent a deep vertical sulcus between the tubercles corresponding to the upper portion of the bicipital groove. The elbow hangs at the side, slightly posterior, and may easily be brought against the body. Of greatest diagnostic importance is the inability to actively rotate the arm outward or abduct it, whereas other motions are normal. If the fragment lies between the acromion and the humeral head, the joint will be locked. Tenderness is noted when palpating over the point of fracture and crepitus may be elicited by rotation and abduction of the arm. The normal length of the arm is not varied, the head of the bone rotates with the shaft and the hand can be placed on the opposite shoulder. If an anterior dislocation of the humerus is present, the characteristic signs of that injury will be added to those just described. Deformity may then become pronounced.

Complications of fracture of the greater tuberosity are dislocations of the head of the humerus, fractures in neighboring parts, recurrence, non-union, atrophy of the infra- and supra-spinatus and teres minor, and impinging of an excessive

callus against the acromion causing an abduction and elevation of the scapula. Complications are fairly uncommon.

Anatomical Neck.—*Etiology.*—These are very rare as isolated fractures, being similar in this and many other respects to fractures of the humeral head. They occur especially in elderly people as a result of a blow or fall directly upon the shoulder or more rarely by a fall upon the hand. They are often found accompanying anterior dislocation. Scudder states that this injury is “far more common than is generally supposed, particularly in middle-aged and elderly people,” but other authorities have seen only rare examples.

To be a true fracture of the anatomical neck the line of separation would have to be entirely intracapsular. This is very uncommon, the break usually extending to neighboring parts, the tuberosities, or surgical neck. Hamilton writes that the fracture line “often follows with remarkable accuracy the line of insertion of the capsular ligament.” The fragments may be impacted or the upper one may lie free within the joint. As a rule displacement is slight but the loose fragment has been found turned completely around. If there is much displacement, the *mechanism* is the same as that in fracture of the surgical neck.

Examination will be similar to that used in diagnosing fracture of the humeral head.

Measurements are usually of no value. If there is marked overriding the arm will be shortened as shown by the distance from the acromion process to the external condyle. Impaction is seldom sufficiently great to give shortening.

Symptomatology.—Physical signs and symptoms of fracture of the anatomical neck are so closely related to those of the humeral head or surgical neck that a differential diagnosis is rarely possible. There are present the usual evidences of severe trauma to the shoulder including swelling and discoloration with ecchymosis. Pain is present in the shoulder, increased on active or passive motion; tenderness is elicited by pressure over the head of the bone or joint. Deformity is seldom great enough to be visible or palpable. If impaction has not occurred, abnormal mobility of the head may be felt and crepitus elicited by rotating the elbow while pressing the head of the bone into the socket. At times, a slight depression may be seen under the acromial process. By pressure in the axilla the head of the humerus is not felt so distinctly in the glenoid fossa as before the fracture. The elbow falls easily to the side of the body or may be placed there; the hand can be placed on the opposite shoulder. Motions of the arm are limited mainly by the resulting pain and then chiefly in the extremes of movement. Swelling may be so slight as to be barely perceptible.

Surgical Neck.—*Etiology.*—Fractures of the surgical neck are very common, being due to direct blows or falls upon the shoulder, blows downward against the upper arm held in abduction and, rarely, to falls upon the hand or elbow. Hyperabduction with pressure against the acromion has also resulted in this fracture which is more common in elderly people because of the atrophy of the cortex at this point as old age advances. In old age the direct causes are chiefly responsible; in youth, the indirect causes.

The fracture line is transverse, oblique, spiral, or comminuted. All fractures between the epiphyseal line and the attachment of the pectoralis major muscle are included in this group although in some cases there may be a prolongation

of the fracture line upward to the head or downward toward the shaft. The transverse type of separation is that most frequently encountered and is present at any age, whereas the spiral variety occurs more commonly in early life. Impaction of the whole or a part of the fragment is not unusual. The displacement depends to some extent on the direction of the violence, but muscle pull is the

main factor.

Mechanism of Displacement.—Due chiefly to the action of the supraspinatus, the upper fragment is abducted and rotated outward. The infraspinatus and teres minor are not allowed to cause lateral displacement because of the inward pull of the subscapularis. The cartilaginous surface of the humeral head falls somewhat downward and loses its normal contact with the glenoid fossa. The lower fragment is always anterior and medial to its normal position and rotated inward by the latissimus dorsi, teres major, and pectoralis major muscles. The lower fragment is always pulled upward by the biceps, triceps, coracobrachialis, and deltoid.

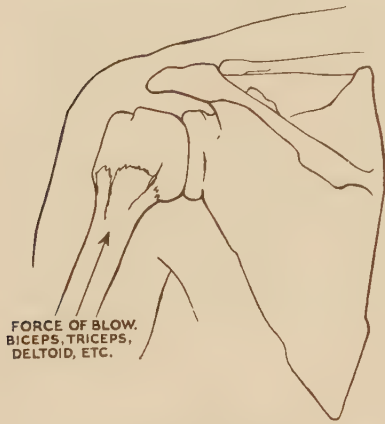


FIG. 10.—IMPACTED FRACTURE OF SURGICAL NECK OF HUMERUS.

neck should cover inspection for deformity, swelling, and signs of injury followed by palpation for deformity, abnormal mobility, crepitus, and tenderness. The axilla should be palpated, for often the lower fragments will be found there. A note should be made of active motion and then careful passive motion attempted. This is best carried out by the examiner placing one of his hands over the site of suspected fracture while with the other he rotates the elbow and abducts and adducts the arm. Finally an x-ray picture must be taken if possible.

The length of the arm may be unchanged but if there is much overriding and tilting inward, the arm will be shortened. This can be determined by measuring from the acromion process to the external condyle, and comparing the injured with the normal arm.

Symptomatology.—Signs and symptoms of fractures of the surgical neck of the humerus include the usual evidences of severe injury to the shoulder region; pain localized more or less in the area of injury, sometimes extending up and down the arms; tenderness, often over a wide area, usually more severe at the point of fracture; discoloration and ecchymosis of the skin with abrasions, contusions, or lacerations; localized swelling which is not sufficiently limited to aid greatly in a diagnosis. If there is no displacement, the elbow hangs at the side with the arm in a state of flexion; if displacement is present, the arm is always held away from the body. There is almost complete inability to use the arm,

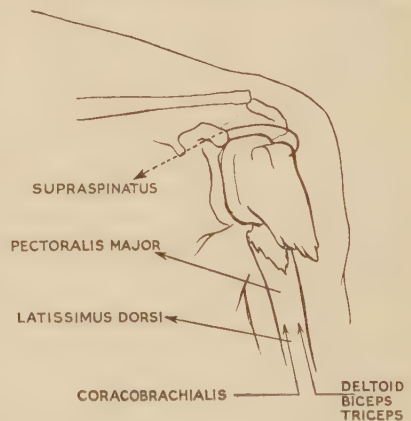


FIG. 11.—NON-IMPACTED FRACTURE OF SURGICAL NECK OF HUMERUS.

with an angular deformity below the insertion of the deltoid. Below the acromion there may be a slight depression. If unimpacted, the head of the bone does not rotate with the shaft and crepitus may be felt; if impacted the head of the humerus rotates in its socket when the elbow is rotated. On active or passive motion the pain is greatly increased. By palpating in the axilla the upper end of the lower fragment may be felt as it is pulled upward and inward; in such a case there is marked shortening of the arm.

Complications are rare, but there may be injury to the brachial plexus and axillary vessels, rupture of muscles, especially the long head of the biceps, and compound fractures with infection and osteomyelitis.

Lesser Tuberosity.—*Etiology.*—Fractures of the lesser tuberosity are due to forcible outward rotation of the arm or sudden contraction of the supscapularis muscle. The isolated fracture is very uncommon, the injury usually accompanying anterior humeral dislocation, fracture of the greater tuberosity or anatomical neck.

Mechanism of Displacement.—The displaced fragment may be found pulled upward by the subscapularis muscle to a point just below the coracoid process. This removes the inner edge of the occipital groove and may allow the long head of the biceps muscle to slip laterally.

Examination should be similar to that of other fractures of the upper humeral extremity. Measurements are of no value.

Symptomatology.—In addition to the usual signs of shoulder injury there is tenderness below the coracoid process where a small bony mass may be palpated. Inward rotation of the arm is impossible but outward rotation is increased so that the arm tends to remain in that position. Crepitus is rarely obtained. The diagnosis is seldom made and never positive without a radiogram which should be made in every suspected case.

Separations of the Upper Epiphysis.—*Etiology.*—This usually occurs before twenty years of age, as a rule between eight and eighteen. It has been reported as an accident of childbirth due to traction on the arm or by the obstetrician's finger hooked in the axilla. After ossification of the epiphysis, and before the twentieth year, the separation is due to direct violence such as a blow, a fall directly upon the shoulder, or to indirect violence as by hyperabduction of the arm. The injury has followed a fall upon the elbow when the arm was abducted. The condition is often recognized only upon radiographic examination.

The upper epiphysis is formed by the head and two tuberosities, the epiphyseal line in its medial course being the same as that of the anatomical neck and laterally running just below the greater tuberosity. The under surface of the epiphysis is concave, deeper in the center than at the edge, so that the shaft of the humerus fits up into the cup-shaped depression. Often, the portion of the shaft so placed breaks off when the epiphysis separates. The centers of ossification of the epiphysis unite with each other about the fifth year and with the shaft about the twentieth year. Thus we see why epiphyseal separation is more common between the ages of eight and eighteen. When such an injury does occur, partial, rather than complete, displacement is the rule. The head is usually in its normal position in the glenoid cavity but does not rotate with the shaft, which is pulled upward and often inward.

Examination will include those same procedures used in fracture of the surgical neck.

If the shaft is completely displaced there will be some shortening as shown by measurements from the acromion to the external condyle. Usually there is no appreciable difference in length between the injured and sound arms.

Symptomatology.—Signs and symptoms of upper epiphyseal separation may be mild or severe. If there is no displacement, the slight deformity will be caused by swelling only. Displacement may be complete and then an abrupt projection will be found in front of the shoulder joint, just below the coracoid process, caused by the projection of the lower fragment. The head of the bone is in the glenoid cavity and therefore there is no flattening of the shoulder. The head does not rotate with the shaft, which is pulled upward, forward, and inward. The anterior axillary line may be shortened and distorted. There is abnormal mobility of the arm and a *soft crepitus* can be felt, if impaction has not occurred. The arm is helpless, active motions being impossible because of the deformity, lack of support, and resulting pain. Passive motions are limited only by the pain. Contusion and ecchymosis of the shoulder region are present with rapid diffuse swelling below the level of the acromion. The elbow is often carried outward and a little backward. When such signs and symptoms are found in a patient less than twenty years of age, separation of the upper humeral epiphysis must be strongly suspected. An x-ray picture will prove the diagnosis.

Complications of this accident are disturbances of the nerve and blood supply, usually the result of pressure of swelling and deformity and causing an arrest of growth of the upper end of the humerus. This is a serious result and always to be kept in mind, in prognosis. Ankylosis of the shoulder joint is rare.

SHAFT

Fractures of the shaft are very common and include all those from the insertion of the pectoralis major to the supracondylar region. The break may be of any variety, usually transverse, but often oblique, spiral, greenstick, or comminuted. Incomplete fractures are rare, usually present in rachitic children. The fracture may be simple (closed) or compound (open). Longitudinal fractures are rare but a few cases have been reported.

Etiology.—These are due to direct or indirect violence. The former are suffered in direct blows, falls with the shaft of the arm striking an object, or in crushing accidents. Indirect violence, as a fall on the hand or elbow or by muscular action occurs here more commonly than in any other bone of the body. Occasionally the humeral shaft is fractured by an insignificant injury; then the bone is usually found to be the seat of some preëxisting pathologic condition as metastatic carcinoma, cyst, or nerve condition such as tabes dorsalis or syringomyelia.

Frequency of Site.—The middle and lower third of the shaft are involved more often than the upper third.

Mechanism of Displacement.—The displacement of fragments depends upon the mode of injury and especially upon the point of fracture. When the upper

third of the shaft is involved, that is, above the insertion of the deltoid, the upper fragment is pulled toward the body by the pectoralis major, teres major, and latissimus dorsi. The lower fragment is drawn upward and outward by the deltoid, while the biceps, triceps, and coracobrachialis increase the overriding. Sometimes the pectoralis major gains the advantage and causes the upper fragment to rotate internally. If the fracture is below the insertion of the deltoid, in the middle third, as is more common, the line of fracture is usually oblique from above downward and outward, while the upper fragment is abducted and elevated by the anterior portion of the deltoid and coracobrachialis, aided by the supraspinatus. The lower fragment being held by the brachialis anticus is not disturbed in a lateral plane but is pulled upward by the biceps and triceps. There is often an angulation in the line of the humerus with the apex pointing backward. In fractures of the lower third there is little tendency to displacement but the lower fragment may be held backward and upward by the pull of the triceps on the elbow.

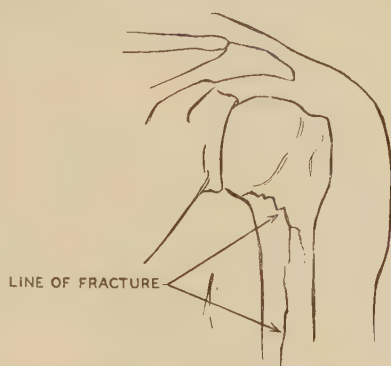


FIG. 12.—FISSURED FRACTURE OF SHAFT OF HUMERUS (NO DISPLACEMENT).

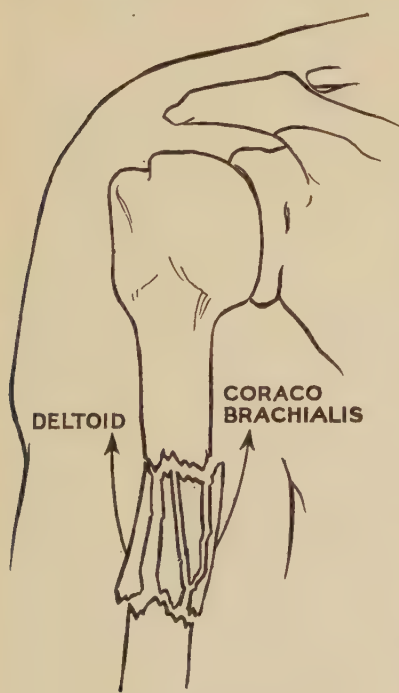


FIG. 13.—COMMINUTED FRACTURE OF SHAFT OF HUMERUS.

Examination for fracture of the shaft of the humerus should begin with a careful inspection for signs of injury, such as bruising, contusion, ecchymosis, swelling, and deformity. The arm should then be palpated and deformity and tenderness determined. Active motion may be followed by careful passive motion, one hand supporting and moving the elbow, while the other hand is placed over the humeral shaft. In this way deformity, abnormal mobility, and crepitus are discovered. Finally radiograms should be taken to determine the exact nature and extent of the fracture.

Measurements of the arm from the acromion to the external condyle will show shortening, if there is displacement with overriding. Comparison must be made with the normal arm. A fracture is often present without shortening.

Symptomatology.—Signs and symptoms of fractures of the shaft of the humerus depend on the type, extent, and location of the separation. In most cases, there is visible evidence of severe injury, as contusion or abrasion with ecchymosis in the region of the fracture. Swelling is usually limited to the fractured area. There is loss of function, inability to use the arm, with pain and tenderness increased on motion or palpation. Abnormal mobility and

crepitus are present. The deformity depends on the site of fracture; in the upper third, the upper fragment is pulled in toward the body and the outer fragment upward and outward so that it overrides to the lateral side; in the middle third, the upper fragment is elevated and pulled away from the body while the lower fragment is drawn upward but is not often displaced; in the lower third, deformity is uncommon but at times there is a slight backward and upward displacement of the lower fragments.

Complications of these injuries are involvement of the nerves and blood-vessels and infection with osteomyelitis following a compound fracture. Injury to the large vessels may be followed by thrombosis and gangrene. Of special importance and not infrequent occurrence is injury to the *musculospiral nerve* with resulting paralysis of the extensors of the wrist and fingers, called wrist-drop. This may appear immediately from tearing of the nerve, within a few hours from stretching or after three or four weeks from compression by callus. (See chapter on "Peripheral Nerves.")

LOWER END

The Elbow.—Fractures of the elbow may involve any of the different parts of the lower end of the humerus or the proximal ends of the radius and ulna. The injury may involve the supra- or inter-condylar region, the external or internal condyle or epicondyle, the capitellum, the trochlea, or the lower epiphysis. They are all classified under elbow region although many of them do not injure the joint proper. Each fracture will be considered separately.

Examination.—Examination for fractures about the elbow should be sufficiently thorough to include such injuries in any part of that region, in the lower end of the humerus or upper end of the radius or ulna. By inspection, external evidences of injury such as wounding of the skin, ecchymosis, and swelling are to be noted. Deformity and the position in which the arm is held at the elbow are important signs. The entire region should then be palpated carefully for deformity and tender points. The relation of the three bony points of the posterior surface of the elbow, the external and internal condyles and the olecranon process should be studied and compared with the normal arm. In health and in full extension these three points are in a horizontal line; in flexion the olecranon drops below the two lateral landmarks while in fracture in this region any displacement may be found, dependent on the exact nature of the separation. Active motion may then be allowed, but will probably be of slight value because of the limited excursion resulting from the pain induced. Passive motion is best carried out under an anesthetic, muscle relaxation being obtained and pain abolished. One hand should hold the lower end of the shaft while the other palpates the different parts of the elbow and manipulates the joints. In this way abnormal mobility and crepitus are discovered. Such is the way fractures of the elbow were once diagnosed but to-day one of the first thoughts is a radiogram. This gives the exact diagnosis with the least pain to the patient and should always be used if possible. But the older method deserves more consideration than has fallen to its lot.

Supracondylar Region.—*Etiology.*—Fractures in the supracondylar region are the result of direct injuries such as severe crushings, received in industrial

accidents. In children, such an injury is frequently the result of a fall upon the outstretched hand when the elbow is hyperextended and abducted.

About half of the cases of fractures of the lower end of the humerus may be classified under the supracondylar variety, most of them occurring in early life, before fourteen years. They have been divided into extension, flexion, abduction and adduction fractures, depending on the line of separation and the displacement.

Mechanism of Displacement.—The line of fracture is usually just proximal to the condyles but may vary somewhat, according to the height of the fracture. A few fibers of the joint-capsule may or may not be torn, but properly speaking, this injury does not involve the joint. In the extension variety, the line of separation runs from just above the anterior attachment of the capsule upward and backward so that the lower end of the humerus may be displaced backward and the upper fragment forward. In the rare flexion type the line of fracture runs from the anterior surface backward and downward and the lower fragment is pushed forward. The line of the abduction fracture runs from inward and below, upward and outward, the adduction type being the reverse of this. These last two are usually incomplete and very uncommon. In children, the usual displacement is upward and backward, dependent largely on the force and direction of the original injury and on the subsequent manipulation. As a rule there is some rotary displacement about the vertical axis brought about by the strong outward rotators of the shoulder being unopposed by the forearm muscles. Commonly, the upper fragment is found to be rotated inward and slightly forward. Greenstick fractures in this area are very uncommon.

Examination.—Measurements are of little value in fractures about the elbow. In some types, shortening will be found, as shown by a measurement from the acromion to either condyle. But this exact distance is not always easy to obtain and measurements alone are unimportant and seldom taken.

Symptomatology.—Physical signs and symptoms of fracture in the supracondylar region will include all those generally present in fractures about the elbow. There will be evidences of trauma, contusions, abrasions, ecchymosis, with swelling, pain and loss of function. In addition there will be a deformity depending on the direction of the displacement. The lower fragment may be carried backward, and a deformity resembling posterior dislocation of the elbow ensues. The condyles are carried back with the forearm, the radius is not separated from the external condyle. The lower end of the radial shaft may be felt lying forward to its normal position. Flexion is limited, but extension is free until checked by pain. The deformity is especially liable to recur after reduction. If the lower fragment is carried forward as rarely happens, the shaft will lie above the olecranon and the elbow proper, anterior to its normal position. Flexion will be only slightly lessened but extension greatly limited. In any case pronation and supination are practically normal and there may be rotary displacement about the vertical axis.

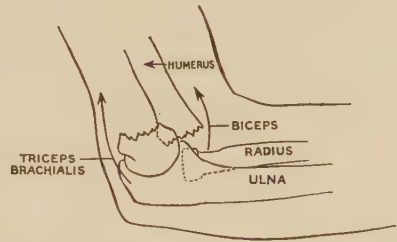


FIG. 14.—SUPRACONDYLAR FRACTURE OF HUMERUS.

Complications of fractures of the supracondylar region are injury to nerves and blood-vessels, infection with osteomyelitis and interference with free joint motion from excessive callus.

Intercondylar Region.—**DIACONDYLAR AND T-FRACTURES.**—*Etiology.*—They are usually due to severe direct violence, closely resembling supracondylar separations, especially of the extension type.

Mechanism of Displacement.—In the true diacondylar variety, the fracture line traverses the olecranon and coronoid fossa, above the epiphyseal line, so that the lower fragment consists of the entire articular surface with the epicondyle and is usually displaced posterolaterally.

A rare variation of the transverse diacondylar fracture is the type described by *Posadas*, caused by flexion in which the lower fragment is displaced forward into the bend of the elbow and complicated by a posterior dislocation of radius and ulna. If not reduced, a false joint may be formed with the lower end of the fragment.

True intercondylar or T-fractures are usually found in adults who have been subjected to severe direct injury. The condyles are broken from the humeral shaft and separated from each other. The displacement may be so varied that no one deformity is typical. They may be identical with supracondylar fractures except for extension into the joint and are often compound with extensive injury to the overlying soft parts. The characteristic signs and symptoms of elbow fracture are present. In addition, there is increase in width between the condyles with independent mobility of these points in relation to each other and to the shaft of the humerus. The condyles may be anterior or posterior to the axis of the shaft or perhaps one anterior, while the other is posterior.

Symptomatology.—The general signs of fracture of the elbow are present; crepitus is best elicited by flexion and extension of the forearm. Abnormal mobility depends on the amount of joint-capsule left attached to the upper fragment, at times there being only hyperabduction and hyperadduction present. The displacement may be so slight that deformity is not apparent. A radiogram should be taken to give the exact diagnosis.

External Condyle.—*Etiology.*—Fractures of the external condyle are more common than those of the internal condyle, and are found more frequently in children than adults and usually result from falls directly on the condyle, the elbow being hyperflexed, or by hyperadduction of the elbow, or by falls on the hand when the elbow is fully extended. In this last case the force is directed along the radius to the capitellum.

Mechanism of Displacement.—The line of fracture may run from the joint surface upward and outward, so that the fragment includes the condyle, epicondyle, capitellum, and a part of the trochlea. The separated portion of bone may be but little displaced but is usually drawn backward and outward, at times with outward rotation. The fragment is still united by ligaments to the head of the radius but can be grasped and moved independently of the other bony parts of the elbow.

Symptomatology.—Swelling is limited to the outer side of the joint with pain

and tenderness only in the region of the external condyle, crepitus, abnormal mobility, and deformity being found only in the same area. The joint is broader than normal, due to the projection of the external condyle. Flexion and extension of the elbow are limited by pain, but pronation and supination are more nearly normal. The forearm may have a slight lateral play, but the ulna is held normally immobile from the humerus.

External Epicondyle.—These are rarely seen but may result from direct blows. Such an injury often accompanies posterior dislocation of the radius and ulna. The symptoms and signs are similar to those found when the external condyle is fractured but are much less marked.

Internal Condyle.—These are very rare, usually resulting from a fall on the extensor surface of the ulna when the elbow is flexed, so that the violence is transmitted upward to the trochlea and internal condyle. Very slight displacement is the rule but at times the fragment is pushed upward, inward, and backward, the fracture line running from the inner border above the internal epicondyle downward and outward to the trochlear surface. The condition is the converse of fracture of the external condyle, the symptoms and signs being largely limited to the region of the internal condyle. There may be a greater increase in lateral mobility, the ulna no longer being held in a firm position. The diagnosis is aided by finding a broadened joint with mobility of the internal condyle; it is proved only by an x-ray picture.

Internal Epicondyle.—*Etiology.*—This is usually an epiphyseal separation, fusion at this point taking place during the eighteenth year. Such fractures are therefore most common before eighteen, as the result of direct violence, a fall on the abducted arm, or from hyperabduction of the elbow while the forearm is in full extension due to the pull of the superficial forearm flexor muscles and internal lateral ligament.

Mechanism of Displacement.—The attachment of the superficial forearm flexor muscles is so close to the base of the epicondyle that ordinarily it is not involved and in very few cases is it torn loose. Such an injury is frequently found with posterior dislocation of radius and ulna. These fractures in adults are not intra-articular and in themselves do not affect the joint. The displacement is generally forward and downward.

Symptomatology.—The usual signs of fracture in the elbow region are present with pain, swelling, abnormal mobility, and crepitus, limited to the region of the internal condyle.

In most cases, swelling and disability are slight and may not appear early. Hyperextension is the most painful movement but active finger flexion or active pronation of the hand will give rise to pain. Inspection may show no change in the elbow, or the prominence of the internal condyle may be shorter and blunter. The ulnar nerve may be injured by laceration or by later callus compression. Rarely, there has been atrophy of all the flexor muscles arising from this bony point.

Capitellum.—This is one of the rarest of distal humeral extremity injuries but has resulted from direct violence or by a force transmitted upward through the head of the radius, the elbow being flexed. It has also been considered as due to

strong upward pull of the biceps muscle forcing the radius against the capitellum. The lesion consists in a separation of the anterior articular surface of the external condyle and is entirely intra-articular. The fragment may lie free in the joint and act as a foreign body. The local reaction is slight but disability severe, and out of proportion to physical signs. The common signs of fracture are present such as pain, tenderness, swelling, and loss of function. According to the position of the fragment either flexion or extension is greatly limited. The condition may resemble fracture of the head of the radius but in some cases palpation will disclose the fragment above and separate from the radius. An x-ray will always clear a questionable diagnosis.

Trochlea.—Fracture of the trochlea is so rare that many writers do not mention it. There is a chipping off of a portion of the trochlear surface usually resulting from a fall upon the hand when the forearm is hyperextended. Symptoms are rather indefinite, often the only diagnosis possible being a severe injury to the elbow with fracture. The joint may become distended with fluid and rarely, the fragment has been palpated.

Separation of Lower Epiphysis.—Separation of the whole lower epiphysis of the humerus may occur up to about the fifteenth year, as the result of a fall on the hand when the elbow is in full extension. The line of separation may be through the epiphyseal cartilage but the older the patient, the more frequently is found a detachment of a small section of the lower end of the diaphysis. The *mechanism* is the same as in supracondylar fracture and, therefore, displacement signs and symptoms will simulate that condition.

Complications of Fractures of the Lower End of the Humerus.—These are compound fractures with infection and osteomyelitis, injury to blood-vessels and nerves, the musculospiral, median and ulnar nerves, Volkmann's ischemic contracture, and cubitus varus or valgus. For discussion of nerve injury see chapter on "Peripheral Nerve Injuries." *Volkmann's contracture* is due to a constriction of the blood-vessels supplying the muscles by too tight a bandage, swelling or other pressure. The muscle-fibers undergo hyaline degeneration and are later replaced by connective tissue. The nerves, particularly the sheaths, are involved. The condition may develop in from six to twelve hours and has occurred even when no constricting dressing was used. Pain is an important precursor, followed early by a boardlike rigidity of the muscles affected, lack of voluntary movements, and painful, limited, passive motion. The flexor muscles are most frequently involved. The elbow is semiflexed, the wrist usually extended, the hand pronated, the metacarpophalangeal joints extended, and interphalangeal joints flexed, the deformity resembling a claw-hand. Sensory disturbances as paresthesia and anesthesia, glossy skin, and trophic ulcers are late manifestations. *Cubitus varus* is an inward or adduction deformity of the forearm or the arm, causing a decrease in the "carrying angle" and usually caused by incomplete or improper reduction of a fracture of the internal condyle or supracondylar region. It is commonly called the *gun-stock* deformity. *Cubitus valgus* is an outward or abduction deformity due to an increase in the "carrying angle" of the elbow, caused by fractures of the lower end of the humerus, especially the external condyle or supracondylar region, or lower epiphyseal separation.

Fractures of Radius and Ulna

ELBOW REGION

Fractures of the radius and ulna may occur in both bones at the same time, in either bone separately, or in any part of either bone. When in the proximal portion, they involve the elbow region and are then divided into fractures of the olecranon, the coronoid process, the head or neck of the radius, upper third of shaft of radius, upper third of shaft of ulna, or the last two combined. The complete consideration of these follows.

Examination for fracture of the elbow region should begin with the history of the injury, how received, height of fall, position of arm, elbow, and hand, and, if possible, manner of landing. The position of the arm immediately after the accident should be noted. In short, everything possible should be learned about the accident because definite types of fracture usually result from certain kinds of injuries. The examination itself should begin with inspection, all clothing being removed down to the waist for comparison and appearances of both arms from the finger to the shoulder noted. The position of the forearm should be noted, whether pronated or supinated; whether flexed or fully extended. Cubitus valgus or varus are determined by studying the presence or absence of a change in the "carrying angle" of the arm. Abrasions or contusions may reveal site of injury. Swelling should be observed and a note made as to its character and location, whether confined to the region of the supinators, to the extensor surface of the forearm, along the flexor group of muscles, in the region of the epitrochleas or limited to the bend of the elbow. In many cases ecchymosis and bullæ will be present. Active movements of the arm should then be attempted; in severe injuries of the elbow, the upper extremity is moved from the shoulder and the elbow held rigid. By careful pressure, motion may be tried which will give information of abnormal mobility, deformity, and crepitus. Only in injuries of an extreme degree will the elbow become flail-like. In every case radiography and fluoroscopy, if possible, should conclude the examination to determine the exact nature and extent of the injury.

Radius.—*Etiology.*—Fractures of the head or neck of the radius are more common since the use of the x-ray, than were formerly supposed. These injuries follow a fall upon the pronated hand when the arm is extended. The two fractures are usually associated and both have the same etiology. In children, traction on the hand and torsion of the forearm may cause an epiphyseal separation. Direct violence is very rarely a cause, but violent jerking of the arm upward (radial abduction and forced extension) has been followed by this fracture. The injury is commonly associated with dislocation of the elbow.

Mechanism of Displacement.—The fracture line is usually transverse, but it may be oblique and, when comminuted, with a fracture of the head, may be

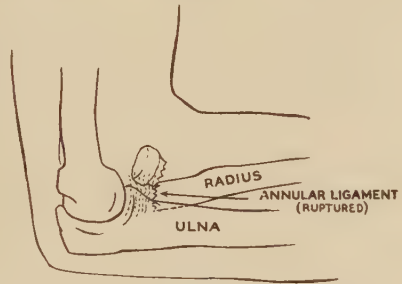


FIG. 15.—FRACTURE OF HEAD OF RADIUS.

in any direction. All these separations are intracapsular so that displacement is not marked. The upper fragment is often displaced backward and outward, while the lower fragment is pulled forward and upward by the biceps muscle. Fracture of the head of the radius may be complete or incomplete and frequently is found to involve the neck. In the complete variety, the fragment may be but slightly displaced or may be within the joint where it acts as a foreign body.

Symptomatology.—Physical signs and symptoms of fractures of the head and neck of the radius have the usual features of any severe injury of the elbow. Pain is present, with marked tenderness near the head of the bone; swelling is as a rule, limited to the fractured region. Disability of the elbow is marked and usually characteristic. The forearm is held semiflexed and partially pronated. Motions of the arm, pronation and flexion and especially supination are markedly limited; complete pronation is impossible. All movements are decreased as a result of the pain. Abduction of the forearm during supination is unbearable because of the pain induced. Crepitus may be found in the region of the head, if impaction has not occurred. The head of the radius does not rotate with the shaft of the bone. If the fragment is large and loose it is easily palpated, especially when displaced outward or forward. Inward dislocation limits flexion completely. If the fracture is comminuted the radius may be pushed to and fro in the direction of its long axis. Fractures of the neck of the radius, more common in children, give rise to painful and limited motion in complete extension, flexion, and especially pronation and supination. The impairment of function is out of proportion to the local signs. Crepitus may or may not be present. An associated fracture of the elbow region frequently overshadows diagnostic signs of fracture of the radius.

Separation of the epiphysis of the radial head is a rare injury occurring between the ages of five and seventeen and caused by traction and torsion of the forearm. The separation may be a part of "pulled elbow" (see "Dislocation of the Elbow"). The forearm hangs uselessly at the side in the position of partial pronation. The condition is definitely recognized only by the aid of the x-ray.

Complications of fractures of the head or neck of the radius and epiphyseal separation are associated fractures and dislocations of other parts of the elbow. There is often present excessive callus with union to the coronoid process or the presence of the fragment within the joint acting as a foreign body.

The Ulna.—*Etiology.*—Fractures of the olecranon, when caused by direct blows or falls upon the elbow, are usually transverse, but may be comminuted and compound. When caused by indirect violence and muscle pull, as by a fall upon the hand or semiflexed forearm, the fracture is always transverse and single. This is caused by the forcing of the ulna against the trochlea of the humerus which produces a sudden contraction of the biceps while the olecranon is held firmly by the triceps. Contraction of the biceps alone has been held accountable, but is very rare.

Frequency of Site.—These fractures are fairly frequent, the separation usually taking place at the constricted portion where the olecranon joins the shaft.

Mechanism of Displacement.—The very tip or extremity is occasionally torn loose. The fracture may be simple, usually transverse, at times oblique, and often compound. When fractured, the olecranon is characteristically drawn upward and backward by the strong triceps muscle; the lateral fibers of the triceps insertion

and the articular capsule having been torn. In some cases in children there is no displacement, the fracture being subperiosteal. In rare cases in adults, where there is no deformity, it is found that the fracture line is transverse and posterior, the fragments being held by the surrounding fibers of the triceps and the articular capsule, which is not ruptured. When the elbow is flexed the displacement is increased; when in full extension displacement may be entirely lacking. There is great similarity between fractures of the olecranon and those of the patella.

Examination for fracture of the olecranon should begin with inspection of the elbow for signs of injury, swelling, and deformity. The region should then be palpated, comparison with the normal arm being made at each step, and tenderness, deformity, abnormal mobility, and crepitus sought. The patient may be allowed to attempt active motion, the resulting pain being a check against further damage. Passive motion should next be tried, limited or excessive movements being carefully noted. When the forearm is both flexed and extended, diagnostic points in the elbow region must be determined. The olecranon should be grasped firmly and lateral motion attempted. Finally an x-ray picture must be made.

Symptomatology.—Signs and symptoms of olecranon fracture include those generally present in such an injury to bone, *i.e.*, ecchymosis, swelling, local pain, tenderness, and deformity. The swelling is greatest on the posterior aspect of the elbow which, with the bony deformity, seems to protrude backward further than normal, giving a characteristic picture. This appearance simulates a forward dislocation of the elbow. The arm is not held in any characteristic attitude, but, in a majority of cases is partially flexed. Pain is most severe in the posterior part of the elbow and tenderness is limited to a small area there; both pain and tenderness are increased on motion of the arm or palpation of the injured region. There is loss of power in extending the forearm, best determined against slight resistance; some extension power may be retained if the periosteum and lateral insertion of the triceps tendon are not destroyed. Abnormal mobility of the olecranon is present and if the fragments are manipulated when the arm is in full extension, crepitus will always be found even though there has been great separation. Before swelling occurs, a depression may be present over the line of separation. The three bony points on the posterior surface of the elbow will have their relation disturbed, the center point formed by the olecranon, rising above the outer two when the arm is in extension. When the forearm is flexed, the separation of fragments will be greater and signs increased; this separation is also in proportion to the amount of effusion into the joint, some of which is always present. The fracture may be imitated by a traumatic olecranon bursitis in which, however, the swelling is more limited, extension not interfered with, and no abnormal mobility present. The radiogram must always be carefully studied and in children, due consideration given to the normal center of ossification which does not unite with the ulna until about the seventeenth year. Fewer mistakes will be made if a radiographic comparison of the two elbows is made. Epiphyseal separation is very rare and can be diagnosed only by roentgenogram.

Complications are compound fractures with infection and osteomyelitis, fibrous union or non-union.

The Coronoid Process.—These fractures usually accompany backward or lat-

eral dislocation of the elbow but a few cases of uncomplicated fracture have been reported. The mechanism of this rare injury is not clearly understood. Some consider the fracture due to a fall upon the ulnar border of the hand; the force being transmitted along the ulna to the coronoid process which is fractured against the trochlea of the humerus. Others think the injury due to forced hyperflexion of the elbow.

W. Howard in a recent personal communication stated that he found a fracture of the coronoid process in about one-third of cases of backward dislocation of the elbow, studied by x-ray.

In any case, if there is no accompanying dislocation, displacement of the coronoid process is slight because it is held in place by the annular and lateral ligaments of the elbow and by the brachialis anticus tendon which is inserted into its base. Where a posterior dislocation is present, the ulna is, of course, forced backward, leaving the coronoid process forward in practically its normal relation to the trochlea. The fragment is therefore separated from the shaft of the ulna but not from the elbow joint proper.

Examination will be similar to that used in other severe injuries of the elbow.

Symptomatology.—Signs and symptoms of fracture of the coronoid process are indefinite unless accompanied by posterior dislocation of the forearm. When a dislocation is present which recurs readily after being reduced, a fracture of the coronoid should be suspected. At times a small, hard mass may be found anterior to the elbow joint, just above the insertion of the brachialis anticus muscle; that is, roughly, a finger's breadth beneath the elbow bend. In some cases this mass interferes with full flexion of the forearm. On pressure over the coronoid process, severe pain may be induced, but it is seldom possible to palpate the fragment; crepitus is unusual.

The forearm has an increased passive movement in the anteroposterior direction and such a motion may be accompanied by slight crepitus. The normal landmarks about the elbow are undisturbed, and in most cases a fracture of the coronoid can be made only by excluding other fractures in this region. A radiogram should always be made so that a definite diagnosis may be obtained.

Complications of fracture of the coronoid process are backward dislocation of the elbow, which tends to recur after reduction, and the presence of the bony fragment in the joint proper, acting as a foreign body. Impaired function is commonly found in the presence of a fragment in the joint.

FOREARM REGION

Fractures of the bones of the forearm may involve both bones simultaneously or separately. The former is more common.

Etiology.—Fractures of both the radius and ulna simultaneously are caused by direct injuries, as severe blows or being run over by a vehicle. Indirect violence, as a fall upon the hand, is responsible in some cases. In a few unusual instances, muscular action has caused the fracture, sustained in a sudden effort to prevent a heavy weight from falling from the hand when the forearm was flexed.

Frequency of Site.—When direct violence is the underlying cause, the site

of fracture may be at any point, usually at the same level for both bones; in the indirect variety, the fractures are commonly in the lower end, somewhat higher in the ulna than in the radius. The fracture may be compound, comminuted, or multiple. The middle third of the forearm is the region most frequently affected; the upper third is rarely involved because of its protected position. In children, greenstick fractures are common, usually in the lower third of the bone, and result from falls upon the hand.

Mechanism of Displacement.—In the usual cases of greenstick fractures shortening is not pronounced because of the support given by the interosseous membrane. There may be an angular deformity with or without overriding. The two upper fragments may be partially flexed and drawn together by the pronator radii teres. The two lower fragments are drawn together and rotated by the pronator quadratus. The lower fragments usually lie posteriorly. The lower end of the upper radial fragment may be adducted so that it lies between the lower fragments. The two fragments rotate on their long axes in opposite directions. In any case, displacement of the fragment will depend upon the direction and force of the violence, the relation of the fracture line to the muscle insertions and to the subsequent manipulation.

Examination for fracture of the forearm should proceed along similar steps to those outlined for the elbow region.

Symptomatology.—Symptoms and signs of fractures of both radius and ulna depend upon the type of fracture and its location. In any case there are present pain, tenderness, swelling, deformity, disability, and abnormal ability. Greenstick fractures of children, being incomplete, give rise to few signs, but the ability to palpate the entire length of the bones aids in determining slight angular deformity. Crepitus is not present; there is no shortening of the forearm. If the fractures are *complete*, the ordinary signs listed above will be more severe and pronounced. There is usually an angular deformity with inward and backward bowing. This will cause a shortening of the forearm and will allow crepitus to be obtained. Pain and tenderness are more severe over the point of fracture. One bone may be completely separated while the other is incomplete. With fractures of *both bones*, pronation and supination are destroyed because the muscular forces employed in these movements are thrown out of equilibrium. Diagnosis of fracture of both bones of the forearm is, as a rule, easily made because of the deformity.

Complications of fractures of both the radius and ulna are open wounds, with infection and osteomyelitis, Volkmann's ischemic contracture, non-union, union with fusion of two bones, fibrous union with pseudo-arthritis or injury to the musculospiral, median or ulnar nerves.

The Radius.—**Etiology.**—Fractures of the shaft of the radius alone, usually due to direct violence are less frequent than those of the ulna. When caused by

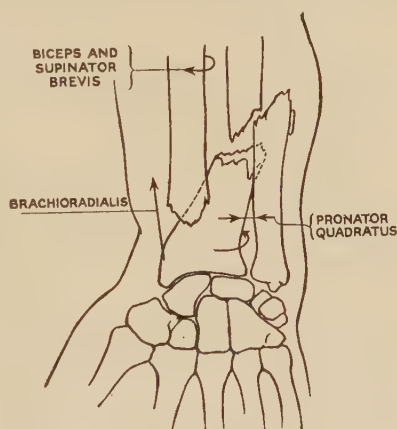


FIG. 16.—FRACTURE OF RADIUS AND ULNA (LOWER THIRD).

a kick-back of an automobile crank it is termed *chauffeur's fracture* and is found in the lower third.

Frequency of Site.—Any portion of the shaft of the radius may be fractured, but the most common site is the lower third, then through the lower level of the epiphysis.

Mechanism of Displacement.—The mechanism of the fracture of the radial shaft depends upon the relation of the fracture line to the insertion of the muscles. If the fracture is proximal to the pronator radii teres, that is, in the upper third of the bone, the lower fragment is drawn toward the ulna and pronated by the pronator radii teres and the pronator quadratus while the upper fragment is supinated by the biceps. Where the fracture is below the middle of the bone, the lower fragment is likewise drawn toward the ulna, while the upper fragment is displaced forward by the biceps and inward by the pronator teres. In fractures in the middle of the shaft, the radius is usually drawn into contact with the ulna, causing an angulation, opening outward. The lower fragment is pronated, while the upper fragment is rotated in the opposite direction.

Examination.—*Radial Head.*—The examiner grasps the hand in the manner of shaking hands. The forearm should be slightly flexed. With the opposite hand the head of the radius, which is felt just beneath the external condyle, should be grasped. By alternate pronation and supination of the wrist, fractures of the radial head are revealed.

Symptomatology.—The diagnosis of fracture of the shaft of the radius alone, is made known by the presence of swelling, pain, tenderness, deformity, abnormal mobility, and crepitus, limited to the radius. These signs are increased when the hand is grasped and the forearm passively pronated and supinated; active pronation and supination are limited.

The Ulna.—*Etiology.*—Fractures of the shaft of the ulna are caused by a direct blow as a fall on the ulnar side of the forearm. Indirect violence, as a fall on the hand, is practically never a cause, because the ulna does not articulate with the carpus.

Frequency of Site.—They may be present at any point but more commonly in the middle third.

Isolated fracture of the ulna is less common than of the radius and ulna.

The mechanism of displacement is fairly definite; the upper fragment usually remains in its normal position, but in some cases it is partially flexed and abducted toward the radius. The lower fragment is displaced outward toward the radius by the pronator quadratus. The two bones frequently come into contact. The ulna is often the site of greenstick fracture in children but only slight deformity is produced. A forward dislocation of the radius is present in many cases of fracture of the upper third of the ulna.

Examination for fracture of the ulna should begin with inspection of the forearm and a comparison with the normal arm. Localized swelling, signs of injury, contusion and abrasions, or ecchymosis and deformity should be noted. The forearm should then be palpated, special care being given to the ulna in its entire length. Abnormal signs to be determined are deformity, abnormal mobility, and crepitus. Active motion may then be allowed, followed by careful passive movement, having in mind the same diagnostic points.

Symptomatology.—Diagnosis of fracture of the ulna is usually easily made by inspection and palpation. The usual signs of severe injury of the forearm are present and limited mainly to the inner or ulnar aspect. The x-ray should be employed in determining the exact location and extent of the fracture.

Epiphyseal separation of the lower extremity of the ulna is rare, because of the strong inferior radio-ulnar ligaments and the triangular fibrocartilage. Falls upon the hand do not involve the lower extremity of the ulna but often give rise to fractures of the lower end of the radius. Epiphyseal separation, however, may occur between the fourth and twentieth year, the separated portion including the styloid process and the surface articulating with the radius. In the usual case there is deformity with backward displacement of the fragment, *soft crepitus* and limitation of motion and supination, because of the resulting pain.

WRIST REGION

Fractures in the vicinity of the wrist joint may involve the lower end of the radius (Colles' fracture); the styloid process of the ulna, the distal extremities of both radius and ulna or any of the carpal bones.

The Radius.—Fracture of the lower end of the radius (*Colles' fracture*) is one of the most common and important in surgery. It constitutes about 10 per cent of all fractures, and ranks next to those of the clavicle in frequency. They were originally described by Colles of Dublin but to-day the name Colles' fracture includes more than the original description of the fracture of the lower end of the radius and has been expanded



FIG. 17.—COLLES' FRACTURE.

to cover practically all fractures of the lower end of that bone. Velpeau called it the "silver-fork fracture" because of the characteristic deformity. In the leg, a Pott's fracture has an etiology and signs similar to Colles' fracture.

Etiology.—These injuries are the result of a fall upon the palm of the hand in a position of pronation, this being the natural position assumed for protection when falling. Occasionally a fall or blow upon the dorsal surface of the wrist is responsible.

Mechanism of Displacement.—Colles' fracture is characteristically an impacted fracture of the distal end of the radius, but many variations are recognized; Roberts and Kelly describe fourteen types. The shaft of the radius is composed of compact bone, but about three-quarters of an inch above the carpal end, the tissue becomes spongy; at this junction, the weak spot of the bone is the usual site of fracture. The anterior radiocarpal ligament is much thicker and stronger than the posterior. When a fall is sustained, rather than the anterior ligament separating, the lower end of the radius to which it is attached is torn away. After the separation has occurred, the weight of the body forces the end of the shaft into the spongy fragment and impaction results; the triangular fibrocartilage is dislocated by the displacement of the lower end of the radius allowing an increased prominence of the ulna, a widening of the wrist, and sometimes causing fracture of the ulnar styloid process. These factors explain the deformities characteristic of Colles' fracture.

Examination for fracture of the lower end of the radius should begin with inspection for deformity, usually sufficient in itself to give a diagnosis. Signs of violence, as contusion or ecchymosis, are to be noted. The wrist joint is then palpated for deformity, abnormal mobility, and crepitus. This is best carried out by grasping the forearm just above the suspected fractured point while the other hand holds and manipulates the wrist. By this procedure both thumbs may be placed directly over the injured area. By shaking hands with the patient with the examiner's other hand over the patient's injured wrist, diagnostic points may be elicited. Active motion and very careful passive motion are then to be tried.

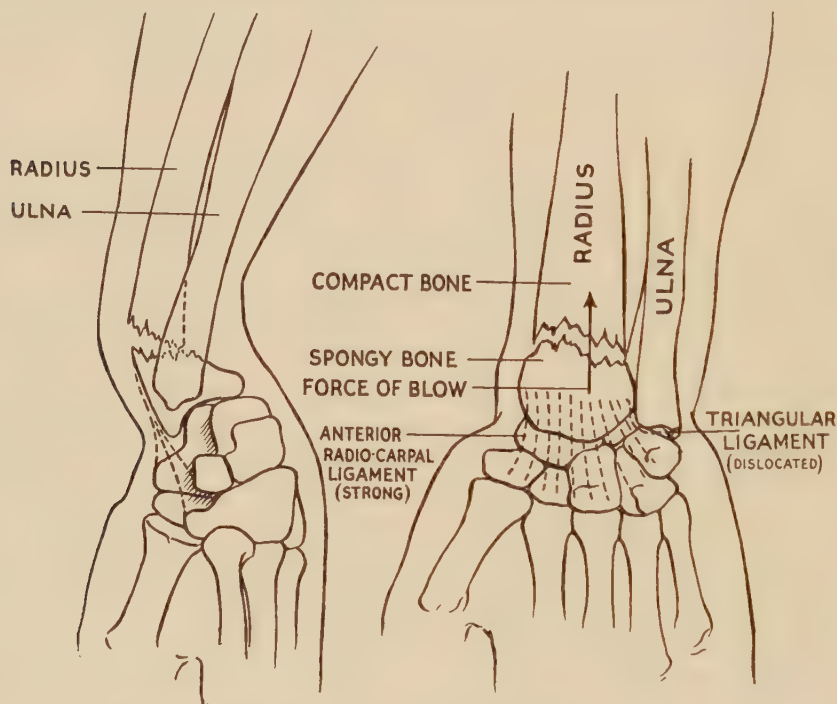


FIG. 18.—COLLES' FRACTURE.

Finally, an x-ray picture must be made to determine the exact point of fracture and displacement of fragments.

Symptomatology.—First, there is a prominence on the dorsum of the wrist caused by the lower fragment being displaced upward and backward and sometimes slightly rotated. Second, the hand is inclined to the radial side because of the strong ligaments which bind it to the distal fragments. Third, the ulna is allowed to become unduly prominent by the dislocation of the fibrocartilage and the separation of the lower end of the radius from the ulna. This causes a widening of the wrist. Fourth, the radius is shortened due to the backward displacement and impaction. The direction of the line of fracture, and the degree of displacement in any case, are due to the force of the violence and to the amount of pronation of the hand when the fall is sustained.

The diagnosis of Colles' fracture may usually be made by inspection alone, the "silver-fork" deformity being characteristic. Gentle palpation may be allowed

but unnecessary force with resulting severe pain is to be discredited. Crepitus and abnormal mobility are seldom present because of the impaction of fragments. General swelling about the wrist joint appears within a few hours and tends to obliterate the deformity. The hand is abducted and the wrist broadened. A valuable diagnostic point is the upper displacement of the radial styloid process, so that it is on a line with, or even above, the ulnar styloid process.

The hand and fingers are held semiflexed; complete flexion is more limited than full extension. On the flexed surface of the wrist the normal radial arch is obliterated. In doubtful cases diagnosis is always to be made by the x-ray.

Complications of fractures of the distal end of the radius are open wounds with infection and osteomyelitis, and fractures or dislocations of other parts of the wrist.

Separation of the lower epiphysis of the radius occurs before twenty years of age and simulates a Colles' fracture, but gives rise to *soft crepitus*, less swelling, and less pain. The deformity is quite constant, consisting of a prominence just above the wrist on the dorsal surface, and a prominence at a slightly higher level on the palmar surface. There is no radial deviation of the hand as in a Colles' fracture. Where the epiphysis alone is displaced, recurrence after reduction is common. After this type of injury, the styloid of the radius is on the same or a higher level than that of the ulna. With this fracture, the upper fragment is supinated unless the fragments are "entangled," while the lower fragment is always pronated but seldom appreciably displaced.

The Ulna.—Fracture of the styloid process of the ulna occurs most frequently as a complication of a fracture of the radius and is present in nearly half the cases of Colles' fracture. When occurring alone, this injury is due to forced abduction of the hand usually sustained in a fall on the ulnar side of the hand. The fracture is usually transverse and near the base of the process. Displacement is downward and outward and may be marked, due to the traction of the lateral ligament. Neither the violence nor the pull of the triangular fibrocartilage plays an important part in displacement. An isolated fracture of the styloid process is very rare. Diagnosis must usually be made by the x-ray.

Fractures of the Carpus

Etiology.—Fractures of the carpal bones occur more frequently between the ages of twenty-five and thirty-five in men who are subject to industrial accidents; they seem to predominate in the right wrist. They are caused either by direct, or more frequently, indirect violence. In the latter case they are due to falls with resulting forced flexion or extension; they frequently accompany other injuries of the wrist, dislocations, fractures of the radius and ulna or metacarpals.

Frequency of Site.—In the order named, the bones most frequently fractured according to Eisendrath, are scaphoid, semilunar, pisiform, os magnum, trapezium, trapezoid, unciform, and cuneiform.

Symptomatology.—Fracture of the scaphoid alone is to be suspected when there is history of a fall upon the extended hand, a swelling localized to the radial side of the wrist joint, tenderness in the anatomic snuffbox when the hand is adducted, and limitation of extension of the hand. Signs and symptoms of

fracture of any of the carpal bones are tenderness, localized to the wrist proper, swelling in that region, and pain on motion of the wrist, especially abduction and adduction. Because of the slight physical signs, diagnosis may not be made for several days or until a radiogram has been taken. Many sprained wrists prove to be fracture of one of the carpal bones when persistent pain, tenderness, and disability call for a roentgenogram. Motions of the fingers are usually normal, but those of the wrist markedly limited. Neither crepitus nor ecchymosis is to be found; swelling is so slight that it may pass unnoticed until comparison with the normal wrist is made.

Measurements.—Severe injury to the carpal bones can be definitely determined by measuring with calipers the distance between the base of the first metacarpal and the styloid process of the radius. Careful comparison must be made with the opposite normal wrist. Variations in measurements from the normal are always present in impacted fractures.

Fractures of the Metacarpal Bones

Etiology.—Fractures of the metacarpal bones are common and are due to direct force. Blows on the knuckles, or between the knuckles and the carpus, are the most frequent causes, while the crushing of the hand between two solid objects is not an uncommon factor in the production of fractures of these bones.

Frequency of Site.—The third and fourth fingers are most frequently involved.

Mechanism of Displacement.—The violence is usually received on the distal end of the bone, in the direction of its long axis. The fracture, as a rule, occurs in the middle of the bone and is transverse, spiral, fissured, or longitudinal. Any displacement is caused by the violence of the injury, muscle pull playing little or no part.

Deformity is unusual except in the transverse variety; there may be then an angular displacement pointing toward the dorsum or palm. Fracture of the base of the first metacarpal bone, that of the thumb, has been given a special name, *Bennett's fracture*, because of the first complete descriptions given by this author in 1886. This injury is also called "stave" of thumb or "*punch fracture*" and is usually caused by a blow on the thumb, especially the right. The Bennett fracture has a characteristic deformity in which the bone, being driven against the trapezium, is broken in an oblique line so that the shaft is displaced backward and upward behind the trapezium. There is a close resemblance to a dislocation of the carpo-metacarpal joint of the thumb.

Examination.—To examine for fracture of the first metacarpal bones, after the hand has been carefully inspected for deformity, the thumb should be extended and the bone grasped between the index fingers and thumbs of both hands of the examiner, one on the front and one on the back, on either side of the suspected fracture. By gentle manipulation abnormal mobility and crepitus may be found and the movement will cause pain at the base of the thumb. When a fracture of the other metacarpals is suspected they are to be examined in practically the same way for deformity, abnormal mobility, crepitus, and tenderness. Active and passive motion should then be attempted and in doubtful cases a radiogram should be taken.

Symptomatology.—The signs and symptoms of metacarpal fracture will de-

pend on the bone affected. In any case, there is pain with tenderness on pressure over the point of fracture. There is usually an angular deformity with the apex pointing either toward the dorsum or the palm. Often the bone at the site of separation projects upon the back of the hand, causing a prominence of the head of the bone in the palm. Swelling occurs after a short time and will cloud diagnostic signs. The hand cannot be closed tightly, that is, the fist cannot be made because of pain and swelling. On palpation the site of fracture can be made out, it being more common to find the lower end of the upper fragment on the dorsum and upper end of the lower fragment in the palm. The knuckle of the involved bone is missing from the line of the knuckles of the normal fingers. In a Bennett's fracture there is typical displacement of the shaft backward and upward behind the trapezium, with the other signs of fracture, *i.e.*, abnormal mobility, swelling, crepitus, and pain at the site of separation. It is impossible to oppose the thumb and index finger, a loss which is very disabling in attempting to pick up small objects. Pressure on the base of the thumb causes pain.

Complications.—Complications of the metacarpal fracture are fractures of the carpal bones or the phalanges, compound fractures with infection, rupture of the volar or digital artery with severe hemorrhage and the formation of a large subcutaneous hematoma.

Fractures of the Phalanges

Etiology.—Fractures of the phalanges are caused by direct violence such as a blow or crushing force, or by indirect violence as a fall upon the extended finger or a blow in catching a baseball. The former may involve any portion of the bone and usually causes a transverse or irregular fracture of the shaft, often compound. Those due to indirect force frequently involve the ends of the phalanges and the articular surfaces. When received in a fall, the distal phalanx is most often fractured.

Frequency of Site.—All the fingers are about equally affected.

Mechanism of Displacement.—The displacement of the fragments is due chiefly to the force of the blow. The extensor and flexor tendons aid in maintaining the deformity and cause some overriding and shortening.

Examination.—Examination for fracture of the phalanges should begin with inspection for deformity and should continue with palpation to determine abnormal mobility and crepitus. Either side of the suspected fracture should be grasped between the index finger and thumb of the examiner's both hands and gentle movement attempted. The skin furrows caused by the joints of the fingers should be inspected and compared with the normal hand, for these lines give better information than any measurements. Finally a radiogram should be taken to determine the extent of the fracture.

Symptomatology.—In any phalangeal bone fracture there is pain in the affected finger, often extending to the palm, and tenderness when palpation or motion is attempted. There is often present a skin wound, due to the injury or caused by the

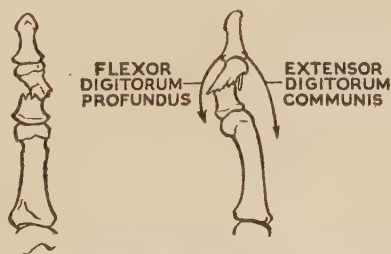


FIG. 19.—FRACTURE OF FINGER.

protruding bone; as a rule there is a visible deformity consisting of rotation of the distal fragment or hyperextension with lateral deviation. When the articular surface is involved the finger is broader and thicker. Abnormal mobility and crepitus are less marked, but there is a definite limitation of motion because of swelling and pain. This is the typical *baseball finger*.

Complications are fractures of the metacarpal or carpal bones and compound fractures leading to infection and osteomyelitis.

Fractures of the Pelvis

Etiology.—Fractures of the pelvis are caused by great violence, such as falls from a height, severe direct blows, or crushing injuries. The body may be crushed between two cars, under the wheels of a vehicle, or by cave-ins. They are more common in industrial workers, especially miners; their occurrence has increased greatly since automobile accidents have become so frequent. The importance and severity of these lesions concern, in addition to the fracture itself, associated injuries. Fractures of the pelvis constitute about 1.2 per cent of all fractures.

Frequency of Site.—The most common are those involving the rami of the pelvis, or the wings of the ilium. All the others, those of the sacrum, coccyx, symphysis pubis, and ischium are rare. The fractures are often bilateral and symmetrical, while those of the anterior half may be accompanied by similar separations in the posterior portions.

Examination.—Examination for fracture of the pelvis should be first aided by a complete description of the accident, how sustained, height of fall, or approximate weight of vehicle passing over body; position of body and especially of the legs. Inquiry should be made as to the ability of the patient to stand or walk immediately after the accident, and to the location of pain and tenderness. The examination proper must begin with careful inspection of the pelvic region for external evidence of injury and deformity. Systematic palpation of the entire pelvis should then be made; by concluding the palpation with a rectal or vaginal examination, practically all bony parts of the pelvis can be reached. The ilium should be palpated for the possibility of a fractured crest. With one hand on each side of the pelvis, compression toward the midline should be made to determine tenderness, abnormal mobility, and crepitus. The pubis and ischium may be palpated externally for crepitus. By rectal or vaginal examination there may be discovered injury to the pelvic soft parts, bony spicules, special points of tenderness, or non-alignment of bones.

Active motion of the legs may be allowed, especially abduction and adduction of the foot and an attempt at elevation of the heels from the bed. Gentle passive movements may be made, one hand being placed on the pelvic girdle, while the other elevates, abducts, and adducts the leg. If the patient has not voided since the injury or is unable to do so, catheterization must be performed to determine possible injury to the urinary tract. A complete abdominal examination should always be made. One should always bear in mind an accompanying thoracic injury. Finally the case should be examined radiographically.

Symptomatology.—The signs and symptoms vary, more or less, with the part of the pelvis affected and will be discussed under the particular fractures.

Fractures of the Rami.—These are due to direct violence received against the anterior portion of the pelvis or to lateral compression. They may be unilateral or bilateral, double or comminuted.

Mechanism of Displacement.—Displacement is not great, as a rule. When it does occur, it is often transient and thus is accountable for the tearing of the bladder and the urethra, so commonly present with this fracture. These organs may be ruptured by spicules of bone or from stress sustained in the separation of the fragments. The most frequent point of urethral separation is at the triangular ligament where the fixed membranous portion of the urethra joins the more mobile bulbous part. The diagnosis is made by the history of the injury, visible signs of trauma such as contusions and discoloration, and local tenderness in the crotch along the course of the normally palpable rami.

Abnormal mobility and crepitus are present, but are not often detected. By pressure medially against both trochanters, pain is increased in the injured area; pushing or pulling the leg in its long axis increases the same symptom. Forced flexion or extension of the hip will evidence pain. Hemorrhage into the scrotum may appear. By vaginal or rectal examination, displacement of the bony part may be directly ascertained. Rupture of the bladder or urethra is diagnosed by catheterization. Radiographs confirm the diagnosis.

Fractures of the Ilium.—These result from lateral compression; they most frequently involve the wing or crest. They vie with fractures of the rami in being the most common of pelvic fractures. There is usually no deformity, but a very slight asymmetry may be noted in some cases. Discoloration on the side of the pelvis, swelling with tenderness, and abnormal mobility may be present. Many times, localized tenderness is the only sign. Separation of the crest is exceptionally painful because every movement of the chest or abdomen brings into play muscles having their origin or insertion in this area. Palpation of the crest is usually sufficient to give the diagnosis.

Fractures of the Anterior Superior Spine.—These are rare injuries; they have, however, resulted from a sudden muscular effort of the sartorius, which has its origin at this point. Direct injuries may produce them. Diagnosis is made by presence of local tenderness and swelling, pain, and abnormal mobility of the spine.

The Double Fracture of Malgaigne.—This type of fracture is due to an injury to the pelvis in which the bones separate, both anteriorly and posteriorly. In front, there is a fracture of the ramus or a separation of the symphysis, while posteriorly there is a separation through the sacrum, iliac point, or medial extremity of the ilium. Any portion of the pelvis may be affected and a very marked mobility of the fragments is a result. One whole side of the pelvis may be displaced upward. The diagnosis is made from the usual signs and by radiographic examination.

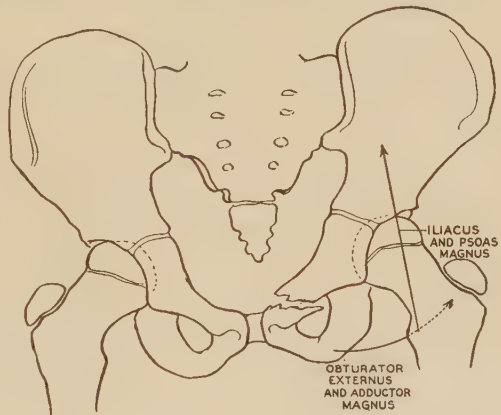


FIG. 20.—FRACTURE OF PELVIS (RAMUS).

Fractures of the Symphysis.—These are, as a rule, due to an anteroposterior compression or straddling. It is very uncommon; a dislocation at this point is more frequent. When fracture does occur there is usually ecchymosis, pain and abnormal mobility limited to the injured area. Pain is increased by direct pressure, by pushing or pulling on the thighs, and by forced abduction. In some cases separation is so wide that it may be palpable.

Fractures of the Sacrum.—This is a rare condition and is usually accompanied by other fractures of the pelvis. They are most commonly a part of the double fractures of Malgaigne. The line of separation is usually vertical and at times may extend into the sacro-iliac joint. If a fragment is forced forward, it may injure the rectum. There is pain at the site of injury, increased by flexing or elevating the body, and very severe upon defecation. Ecchymosis and swelling may be visible; abnormal mobility with crepitus may be ascertained. By rectal examination, the lower fragment can be further displaced.

Fractures of the Coccyx.—This condition is extremely rare and presents the same symptoms and signs as does a fracture of the sacrum. This injury has been greatly overrated; its actual occurrence being one of the rarest fractures in surgery.

Fractures of the Acetabulum.—These may be marginal or central. The former is a complication of dislocation of hip, the posterior rim being knocked off. The latter results from a forcible driving in of the head of the femur. This injury would be more common were it not for the fact that the femoral neck usually breaks. The symptoms depend upon the amount of injury and the extent of penetration of the acetabulum by the femoral head. An hematoma may be found both externally and on bimanual palpation. The trochanter approaches the spine of the pubis. A roentgenological examination must be made to determine the exact diagnosis.

Complications.—Complications of fractures of the pelvis are injuries to the bladder, urethra, pelvic blood-vessels, and nerves. Infection with abscess formation and peritonitis may result from rupture of some part of the urinary tract or from open wounds.

Fractures of the Femur

Upper end	{ head { neck { upper epiphysis { through the trochanters { greater trochanter { lesser trochanter
Shaft	{ subtrochanteric region { upper third { middle third { lower third
Lower end	{ supracondylar region { external condyle { internal condyle { lower epiphysis

Etiology.—Fractures of the femur are commonly found and are, as a rule, due to falls or an attempt to save oneself from a fall. As a general rule, these fractures

are more common in advanced age, although many are seen in adults exposed to severe industrial accidents.

The occurrence of femoral fractures is becoming very much more frequent in children, owing to the advent of the automobile. The fracture may be transverse, oblique, spiral, longitudinal or fissured, comminuted, impacted, simple or compound, with or without displacement. In short, practically any type of fracture may be found in the femur.

Frequency of Site.—The most common fractures of the femur are those of the neck (especially in the aged), the upper epiphysis (in the child), and the middle third.

UPPER END

Examination.—An examination of the hip should be carried out with a routine method, being mindful of the following points: Ascertain as complete a history as is possible of the accident; how received, height of the fall, and the original position of the foot, leg, and thigh after the injury. The examination itself should determine the following: (1) External signs of trauma; (2) position of leg and foot, whether rotated internally or externally; (3) amount of apparent and real shortening of the leg.

The *apparent shortening* is the visual difference between the height of the in-

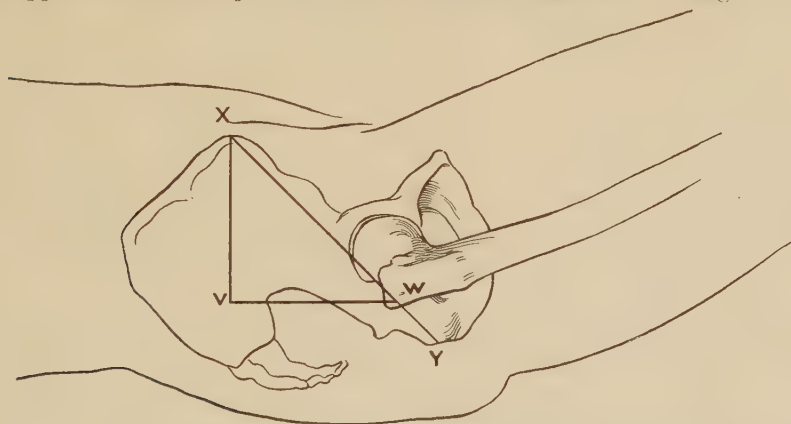


FIG. 21.—MEASUREMENTS USED TO DETERMINE HIP MEASUREMENTS.
Line *XY*: Nélaton's line. Triangle *XVW*: Bryant's triangle.

ternal malleoli, when the patient lies flat on the bed with the legs straight and parallel.

Real shortening is determined by *measurements* and, if carefully and accurately performed, is the most reliable guide in determining the actual condition. It is essential in the taking of these measurements that the patient lie in the dorsal decubitus with the pelvis and legs lying in an even anatomic position. It is helpful to place upon the skin a small mark over corresponding regions from the points where measurements are taken. Comparison must always be made with the normal side. Various methods in the determination of shortening are in use. The most important ones are as follows:

1. The distance from the anterior superior iliac spine, across the center of the patella to the internal malleolus of the same leg.

2. The relation of the greater trochanter to Nélaton's line, which is determined by drawing a straight line from the anterior superior spine to the ischial tuberosity (normally this line passes along the upper border of the trochanter). The same line should be drawn on the opposite side and a comparison made.

3. Bryant's triangle is mapped out by drawing a perpendicular line from the anterior superior spine of the ilium to the bed. From this line the horizontal distance to the greater trochanter is measured and compared with the opposite normal side; normally the distance is $2\frac{1}{2}$ inches.

W. P. Howard and P. M. Hickey have suggested a radiographic method of determining femoral shortening. It is especially suited for all types of cases in which there is a question as to shortening. By means of cassettes sufficiently long to take in the entire length of the femora, one makes an exposure at a distance of 6 feet. The developed films when dried, are marked by drawing lines through corresponding points in each acetabulum—a parallel line is then drawn, tangent to the head of both femora. A third line, parallel to the lines just mentioned, passes tangent to the summit of the great trochanter on the injured side and a fourth line passes tangent to the summit of the great trochanter on the uninjured side. The difference between the summit of the trochanter on the affected side and that of the trochanter on the unaffected side, represents the actual shortening.

Following the taking of accurate measurements, active motion of the thigh is allowed; in case of fractures it will be practically absent. Passive motion is then gently carried out; rotation of the ankle with one hand, while the other firmly grasps the upper portion of the thigh, will generally determine the presence of abnormal mobility if a fracture is present. Every examination should be followed by the taking of radiographs.

Head and Neck.—*Etiology.*—Fractures of the head and neck of the femur are usually the result of a slip or a slight fall upon the side or buttocks. They are found most frequently in elderly persons, due to structural changes in the bone. They are most common after fifty years of age and after seventy years make up one-third of all fractures at that period of life. They are more common in women than in men. Fractures of the neck are usually divided into those at the junction of the head and neck and those at the base of the neck; the former are truly intracapsular, the latter extracapsular. This difference is of little importance clinically.

Mechanism of Displacement.—The upper fragment remains in its normal relation to its acetabulum, but the lower fragment is drawn upward by the strong muscles uniting the thigh with the trunk and rotated outward by the external rotators of the thigh and by the force of gravity.

Examination.—An examination for the detection of fractures of the head and neck of the femur should be similar to that given for determining such injuries in the hip region.

The signs and symptoms are the same whether at the superior part or at the base.

Symptomatology.—One of the main findings is a complete loss of use of the leg. The foot cannot be rotated inward, the heel raised from the bed, nor the thigh flexed. In a few cases of impacted fracture, movements have been retained but markedly reduced. By pressure over the trochanter or anterior portion of the hip, severe pain is, as a rule, elicited. More or less pain is constantly present in the hip

region. The position of the leg is characteristic; the outer border of the leg and foot rests upon the bed. Inversion of the foot is impossible. When impaction has occurred, slight shortening of the leg will be noted. In cases of non-impaction, the shortening may vary from 1 to 3 inches. *The trochanter is found elevated above Nélaton's line and the base of Bryant's triangle shortened.* The presence or absence of impaction is important from the point of diagnosis and prognosis. It is present, however, in a great majority of cases and obliterates crepitus, and to a large extent, abnormal mobility. Pain in these cases is less. Usually there is a distinct loss of the hollow behind the trochanter. In very rare cases inversion has been found, probably due to a difference in the direction of the fracturing force.

Complications.—Complications of fractures of the head and neck of the femur are fractures of the pelvis, non-union, and severe shock which, in elderly patients, frequently causes a fatal termination.

Upper Epiphysis.—**Etiology.**—Fractures of the upper epiphysis of the femur are rare in adults, but may be due to the same injuries which cause fracture of the neck, *i.e.*, falls on the buttocks, trochanter, or on the feet. These injuries are more common in children. The line of separation corresponds to the junction of the articular surface with the femur itself; a small portion of the diaphysis of the neck may separate with the epiphysis.

Mechanism of Displacement.—The mechanism of displacement is the same as that for fracture of the neck of the femur. The shaft and neck are pulled upward; the epiphysis remains in place.

Examination.—Should be carried out along similar lines as in fractures of the head and neck.

Symptomatology.—The symptoms of epiphyseal separation may be mild and are similar to those found in fracture of the neck. In some cases “soft” crepitus may be noted. There may be an increase in the prominence of the trochanter, made greater by flexion. *Coxa vara* may result from such trauma and may be confused with coxa vara resulting from lessened resistance of the bony tissue, manifesting itself at the age of puberty. In both types, similar shortening is found with an inability to actively or passively abduct the leg.

Acetabulum.—Fractures of the acetabulum have been considered under “Pelvis.”

Through the Trochanters.—**Etiology.**—Fractures through the trochanters are fairly common and usually result from severe violence. They are especially found in adult life. The leg, at the time of injury, is usually in a position of marked adduction, or the blow is received upon the trochanteric region itself. Sometimes these fractures are in the nature of torsions with the fracture line running between the neck and the intertrochanteric area.

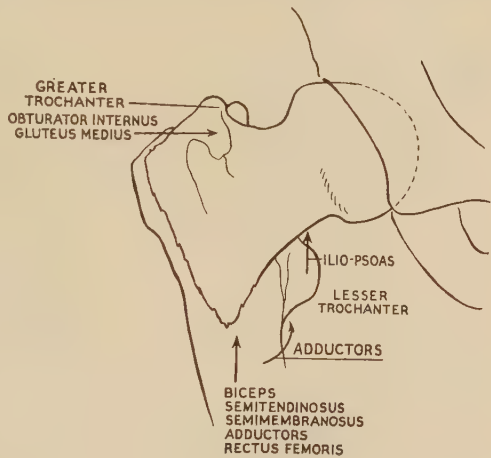


FIG. 22.—INTERTROCHANTERIC FRACTURE OF FEMUR.

Mechanism of Displacement.—The upper fragment is pulled upward and rotated outward by the psoas and iliacus muscles. This is the important difference between fracture of the neck and that of the trochanters.

Symptomatology.—The symptoms of fractures through the trochanters are complete disability of the leg, limitation of passive motion, and slight shortening of the leg with eversion of the foot. There is swelling about the trochanteric region with an obliteration of the digital fossa. Crepitus is rarely obtained. If impaction has occurred, the greater trochanter will rotate with the head. Pain and tenderness are found in the region of the greater trochanter.

Greater Trochanter.—*Etiology.*—Fracture of the greater trochanter is fairly uncommon and is usually due to direct violence. In a few cases muscular pull is held accountable.

Mechanism of Displacement.—The fragment is drawn upward and backward by the action of the gluteus medius and minimus muscles.

Symptomatology.—There is swelling and thickening in the region of the trochanters, with pain and tenderness in that location. At times the fragment may be palpated and moved. Disability is only partial but motion of the leg is painful. There is no shortening of the leg. One of the most important physical signs is the loss of active abduction.

Lesser Trochanter.—*Etiology.*—Fracture of the lesser trochanter alone, is extremely rare, but it is a frequent complication of a comminuted fracture of the intertrochanteric region. Isolated fractures have been noted as a result of muscular action of the psoas and iliacus muscles and are usually found in adolescence.

Symptomatology.—There is local pain and tenderness, which is increased on active flexion or passive extension. Extreme external rotation and varying degrees of helplessness may be present.

SHAFT

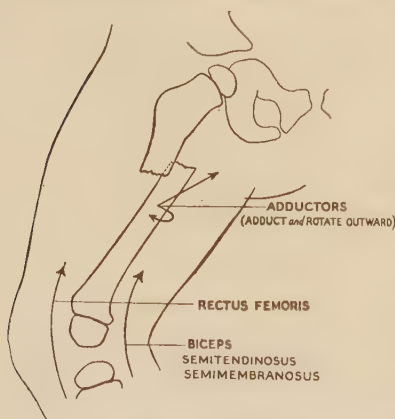


FIG. 23.—FRACTURE OF UPPER THIRD OF SHAFT OF FEMUR.

Subtrochanteric Region. — *Etiology.* —

Fractures of the subtrochanteric region are fairly common and are similar to those of the upper third of the shaft. They are due to direct or indirect violence. The former usually being transverse; the latter, either oblique or spiral.

Mechanism of Displacement.—In these fractures the upper fragment (of greatest importance) is abducted by the gluteal muscles, and externally rotated by the iliopsoas group. The lower end of this fragment often penetrates the muscle and causes the prominence beneath the skin; an angulation is then formed with the apex pointing outward. The lower fragment is drawn upward and rotated inward by the rectus femoris, adductors, biceps, semitendinosus, semimembranosus, and thus the leg is shortened.

Examination.—Examination for these fractures should proceed along similar lines to those given for fractures about the hip.

Symptomatology.—The symptoms of subtrochanteric fractures and those of the

upper third of the femoral shaft are swelling, pain and tenderness, and ecchymosis in the upper portion of the thigh. There is total disability of the leg with extreme outward rotation of the foot. Shortening is always present, usually greater in the oblique variety than in the transverse. There is angulation in the upper third of the thigh; the apex pointing laterally and the lower end of the upper fragment just beneath the skin. The leg below the point of fracture is freely movable in all directions, and motion elicits crepitus at the point of separation. When the leg is rotated, the trochanter does not move.

Complications.—Injury to the blood-vessels and nerves, non-union, and deformity.

Middle Third.—*Etiology.*—Fractures of the middle third of the shaft of the femur are due to direct or indirect violence. The former are suffered from blows, crushing injuries, the passing over the leg of a vehicle, gunshot wounds, etc. Indirect violence is sustained by a fall upon the feet. The middle third of the femur is the most common site of femoral fractures. They are more frequent in adult males subject to severe industrial accidents. The fracture line is usually transverse but may be spiral, oblique, comminuted, simple, or compound.

Mechanism of Displacement.—The mechanism of displacement in fractures of the shaft of the femur is complicated because of the great number of powerful muscles in this region. There are five muscle groups whose equilibrium is disturbed by such injuries, viz.: (1) The pelvic trochanteric group, acting upon the upper third of the shaft, causes an outward rotation of the thigh with abduction and slight flexion on the pelvis. (2) The adductor group adducts and slightly flexes the upper fragment. This group causes a rotation either inward or outward according to the implication of the lower part of the adductor magnus. If the fracture occurs above this part of the muscle, its inward rotating action is excluded and external rotation occurs. (3) The long posterior muscle group (biceps, semimembranosus, semitendinosus) pulls the lower fragment upward. (4) The quadratus femoris displaces the lower fragment vertically upward. (5) The gastrocnemius and soleus rotate the free lower fragment backward with the condyles as an axis; this occurs in supracondylar fractures only.

Examination.—Examination for fracture of the femur should begin with the history of the injury, how sustained, relation of foot and leg, and their position immediately following the injury. After all clothing has been removed from the waist down, the leg should be inspected for signs of injury, contusion and ecchymosis, deformity and swelling. Palpation may then be employed to determine deformity, abnormal mobility, and crepitus. Active motion may be allowed but will probably be negative; even this sign is of great value. Gentle passive motion may then be attempted and abnormal mobility and crepitus sought. By grasping the

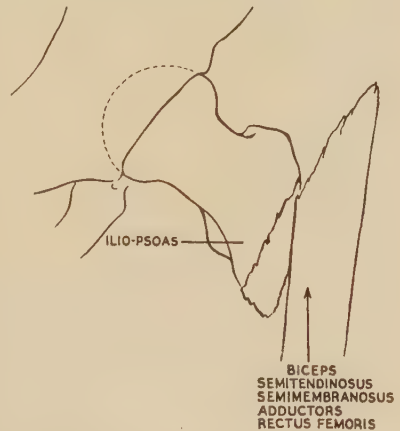


FIG. 24.—SUBTROCHANTERIC FRACTURE OF FEMUR.

In this case the lower fragment has been pulled upward and outward.

ankle with one hand and rotating the leg while the other hand is placed on the thigh over the suspected point of fracture, diagnostic signs may be more readily elicited. Measurements of the legs must then be made to determine apparent measured or real shortening. Finally, in every case, a radiogram must be made.

Symptomatology.—Diagnosis of fracture of the shaft of the femur is comparatively simple if a systematic examination is performed. There are external evidences of the injury with angular deformity at the site of fracture. Voluntary motion is completely lost and any motion increases pain and deformity. The leg is shortened—the knee, leg, and foot are everted. Abnormal mobility and crepitus are present.

Complications.—Injury to blood-vessels and nerves, non-union, deformity and infection (if compound).

LOWER END

Supracondylar Region.—*Etiology.*—Fractures of the supracondylar region are those of the lower third of the femur. They are due to the same causes as fractures higher in the shaft, which are direct or indirect violence. They are comparatively rare, but of special importance because of complications.

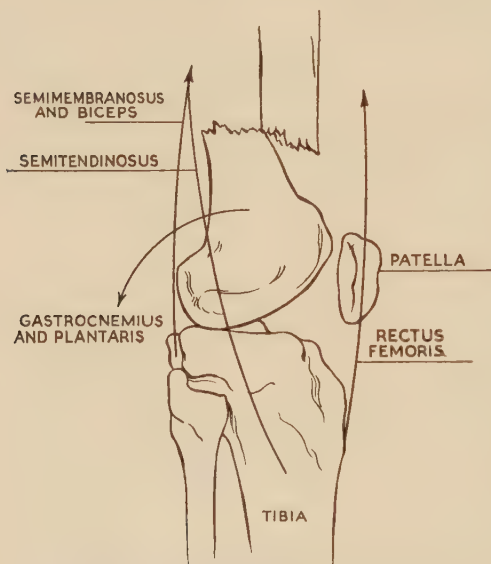


FIG. 25.—SUPRACONDYLAR FRACTURE OF FEMUR.

Mechanism of Displacement.—The upper fragment is displaced forward, sometimes slightly outward or inward, and may pierce the tendon of the quadriceps. The lower fragment is pulled upward by the long posterior muscle group, especially the biceps, and backward by the gastrocnemius and soleus. This last movement rotates the jagged end of the bone into the popliteal space where the popliteal artery, vein, or nerve are frequently lacerated.

Examination.—Examination should follow similar lines as those used in fracture of the middle of the shaft.

Symptomatology.—Signs and symptoms of fractures in the supracondylar region are similar to those generally found higher in the shaft, such as loss of function, abnormal mobility, crepitus, pain, and deformity. The upper end of the lower fragment may be felt just beneath the skin of the popliteal region. Extension into the joint will give rise to severe pain and effusion.

Complications.—Complications of supracondylar fracture are: Extension into the joint, compound fracture with infections and osteomyelitis, or laceration of the popliteal blood-vessels or nerve. Gangrene of the leg may follow rupture of the popliteal artery.

Internal and External Condyle.—Fractures of either internal or external condyle are very rare. Symptoms are similar to fracture of the femur but limited to a very small area corresponding to the point of separation.

Lower Epiphysis.—*Etiology.*—Fracture of the lower epiphysis of the femur is an infrequent accident resulting from abduction or hyperextension of the knee and occurs before the twenty-first year. A common cause has been the catching of the legs between the spokes of a revolving wheel.

Mechanism of Displacement.—There is usually no splintering of the shaft; the knee joint is intact; there may be no displacement, but at times the fracture is compounded. The displacement of the lower fragment is generally anterolateral; the shaft may be forced backward and downward into the popliteal space.

Symptomatology.—Diagnosis of fracture of the lower epiphysis is made by the history of the accident, swelling about the knee with tenderness, evidence of subcutaneous trauma, abnormal mobility, deformity, and loss of function. Soft cartilaginous crepitus may be present. Great pain is induced by pressure on the popliteal nerve and circulatory disturbances in the leg from injury to the artery may be noted. The age of these patients, usually between ten and twenty, is an important factor to bear in mind.

Complications.—Complications are similar to those found in supracondylar fracture.

Fractures of the Patella

Etiology.—Fractures of the patella are due in 80 per cent of the cases to direct violence, such as a fall or blow. In a very few cases the fracture is due to contraction of the quadriceps muscle; usually there is a combination of muscle contraction and indirect violence, as in making a false step when descending a flight of stairs and attempting to save oneself from a fall. These injuries are rare in childhood, the majority of cases occurring in middle adult life between the ages of thirty and fifty.

Mechanism of Displacement.—The fracture may be transverse, oblique, longitudinal, comminuted, or subperiosteal, and either open or closed. As far as the mechanism and symptoms are concerned, all cases can be classified as transverse or comminuted. Flexion of the knee is most important in the mechanism of patellar fractures, especially those in which muscular contraction plays a part. The sesamoid bone is placed between the resistance of the ligament fixing it to the tibia and the quadriceps muscle. If this resistance is less than the pull of the muscle, a fracture results. Such an injury is sustained because a portion of the posterior surface of the patella rests against the condyles of the femur, which act as a point of leverage when a pull is exerted on each end of the patella. The tendon, fibrous aponeurosis, and joint-capsule are torn to a varying extent, from a slight tear to a complete, wide separation. In a comminuted fracture there may be but little separation of the fragments, but in the transverse variety wide separation is the rule, increased on flexing the knee. This is brought about by muscle and tendon pull and after a short lapse of time by joint effusion and hemorrhage. The fragments are usually tilted forward at the line of fracture.



FIG. 26. — FRACTURE OF THE PATELLA.

Examination.—Examination for fracture of the patella must include a careful inspection of the injured knee for visible deformity and swelling; a comparison with the normal side should be made. The region should be palpated for swelling, separation of the fragments, crepitus, and hemorrhage within the joint. If no definite physical signs are made out by inspection and palpation, active and passive flexion and extension of the knee should be attempted. Finally a radiogram may be needed to show a small fracture without separation.

Symptomatology.—The symptoms and signs will depend on whether the fracture is transverse or comminuted. In the first case there is usually a visible and palpable separation of the fragments with the superior fragment drawn upward. A depression can be felt between the pieces of bone. There is a sudden loss of ability to extend the knee so that the leg cannot be straightened. In most cases there is an inability to stand on the affected leg, but in a few instances walking has been possible. This is accomplished by swinging the leg forward at the hip and keeping the tibia and femur locked in a straight line, with the heel on the ground. When lying on the back the heel of the affected leg cannot be raised from the bed. There is present a rounded swelling of the whole knee with discoloration due to subcutaneous hemorrhage. Tenderness is present on pressure over the patella, but pain is not as severe as in an arthritic condition, because rupture of the joint-capsule prevents intra-articular tension. If the fragments are not widely separated and if the muscles can be released, crepitus may be elicited by rubbing the fragments together. The greater the amount of joint distention and the more completely lacerated the lateral aponeurosis of the knee, the greater will be the separation of the fragments. When a fracture is comminuted, there is little or no separation of bony parts. If the ligament is intact, even though the bone is splintered into several pieces, there is no reason why the leg cannot be extended. There are pain and tenderness in the knee with external signs of injury such as contusion and ecchymosis. Effusion is present in the knee joint and, at times, in the prepatellar bursa. Swelling is definite but more irregular than in the first variety, seldom extending into the soft tissues. There is loss of function which is due principally to pain in moving the knee, accompanied by mobility of the fragments and the resulting crepitus.

Complications.—Complications which may occur are fractures of the femur, tibia, or fibula, compound fractures with infection, osteomyelitis, arthritis, fibrous union, or adhesion to the femur.

Fractures of the Knee and Lower Leg

Fractures in the vicinity of the knee joint may involve the lower epiphysis of the femur, the patella or upper end of the tibia or fibula. In spite of the many regions which may be involved, fractures about the knee are not especially common. In every case a systematic examination must be made and a complete history of the accident obtained with information as to the position of the knee during and after the trauma. The region is to be inspected for deformity, swelling, or ecchymosis. Palpation is then used to determine deformity and especially the presence of fluid within the joint. Active motion, if possible, may be allowed, if followed by passive motion to determine abnormal mobility and crepitus.

Fractures of the lower end of the femur, epiphyseal separation of the femur and fracture of the patella have already been considered.

Upper End of Tibia and Fibula.—*Etiology.*—Fractures of the upper end of the tibia and fibula may be due to direct or indirect injuries; the former follow blows or falls upon the bone; the latter occur after falls upon the feet. Injury to these two bones may occur simultaneously or separately.

Frequency of Site.—A single fracture usually involves the tibia. The most frequent fracture is an oblique separation of either the internal or external tuberosity. Transverse and longitudinal fractures are infrequent. Extension into the knee joint is the rule, but extra-articular fractures are, at times, found.

Mechanism of Displacement.—The tuberosity is seldom displaced to any great extent; in a transverse fracture, the lower fragment slides backward, producing a deformity known as *bayonet leg*.

Examination should follow a procedure similar to that outlined for fractures of the knee.

Symptomatology.—The diagnosis of fracture of the upper end of the tibia may be difficult if a few hours have elapsed from time of accident, and swelling and effusion are present. External signs of violence, such as contusion and ecchymosis, will be present, severe pain in the region of the knee will be complained of, and a tenderness will be noted, most marked over the actual point of fracture. Manipulation of the knee will show abnormal mobility and will elicit crepitus. There is seldom appreciable shortening of the leg, but if both tuberosities are broken, a widening of the knee joint will be present. A radiogram should be taken in every case of severe injury of the knee.

Upper End of the Fibula.—*Etiology.*—Isolated fractures are rare, but may be due to muscular action of the biceps or forced adduction of the leg. The usual signs of severe bone injury are present but limited, of course, to the head of the fibula. A complication of this fracture is injury to the peroneal nerve with paralysis of the peronei muscles and inability to raise the outer border of the foot.

Tibial Tubercle.—Separation of the tubercle of the tibia is an unusual injury, occurring most frequently in adolescents and due to sudden contraction of the quadriceps extensor. Pain and tenderness are limited to the region of the tubercle, with inability to fully extend the leg on account of pain. There is lameness, tenderness on palpation, slight increase in height of the tubercle, but seldom crepitus.

Upper Epiphysis of Tibia and Fibula.—Separation of the upper epiphysis of the tibia and fibula is very rare, but may be due to hyperextension, forced abduction or adduction of the leg. The accident usually occurs in individuals from three to twenty years old and gives the same general findings as a fracture, but with less deformity and "softer" crepitus.

Shaft of Tibia and Fibula.—*Etiology.*—Fracture of the shaft of the tibia and fibula is a common injury, making up about 11 per cent of all fractures. Both bones may be broken at the same time or separately. They occur usually from direct violence such as blows or by being run over, and at times by indirect force, such as sudden forced abduction or adduction of the foot.

Frequency of Site.—The middle and lower thirds are most frequently affected.

Mechanism of Displacement.—Displacement is more marked in the tibia than in the fibula. The upper fragment is pulled forward by the quadriceps femoris while

the muscles of the calf attempt to displace the lower fragment backward. An angular deformity is thus formed with the apex backward. The lower fragment is often rotated internally or externally by the weight of the foot. As a rule, displacement is not marked. The fracture line is usually oblique, but is spiral in many cases. The line of separation usually runs from below and anteriorly, backward and upward.

Examination.—Examination for fracture of the shaft of the tibia and fibula should follow the method just outlined for injuries of the knee, *i.e.*, history of accident, inspection, palpation, active and passive movements, measurements, and x-ray examination.

Symptomatology.—The diagnosis of fractures of the shaft of the tibia and fibula is not often difficult. The fracture is discovered by the presence of deformity, swelling, signs of injury, pain and tenderness, abnormal mobility and crepitus, and complete disability. A radiogram should be made, not so much to discover a fracture, as to give the exact extent of the injury.

Complications.—Complications of fractures of the shaft of the tibia and fibula are open wounds, with infection and osteomyelitis, non-union, injury to nerves and blood-vessels producing paralysis, or gangrene of the foot.



FIG. 27.—FRACTURE OF MIDDLE THIRD OF TIBIA AND FIBULA.

Fractures of the Ankle

Injuries in the vicinity of the ankle may involve the lower end of the tibia or fibula or any of the tarsal bones.

Lower End of Tibia and Fibula.—*Etiology.*—

Fractures of the lower end of the tibia and fibula are all commonly termed *Pott's fracture*. They are due to direct violence as a blow or fall, or to indirect violence as a fall with forced adduction or abduction.

Mechanism of Displacement.—If the original and greatest motion is eversion, the lower end of the tibia is fractured, followed by the fibula. Conversely, the lower end of the fibula is fractured by forced inversion. In transverse fracture of both bones, the foot is pulled backward and upward by the gastrocnemius, soleus, and plantaris, and the shaft projects forward. With an oblique fracture, the foot is rotated backward in the same way, the front of the lower fragment projects anteriorly and upward while the upper fragment is pulled downward and backward by the flexors of the foot. Some lateral deviation always exists, but in no constant direction. As the foot is everted, strain is thrown upon the strong internal lateral ligament which, instead of rupturing, pulls off the internal malleolus. If the strain continues the external malleolus is forced outward and the fibula breaks from 1 to 3 inches above the malleolus, at its weakest point. In this way there is brought about an outward displacement of the foot, prominence and tenderness of the internal malleolus, widening of the joint, and often backward displacement of the foot.

Examination.—Examination for fracture of the lower end of the tibia and fibula should begin with a complete history of the injury, how sustained, position

of foot when violence was received, and immediately after the accident. Careful inspection must be made for location of swelling and deformity. Palpation is to be used to determine deformity and tender points. Active motion may be allowed, followed by gentle passive movements to elicit abnormal mobility and crepitus. A good method is to grasp the foot so that the fingers lie over the internal malleolus, the palm against the sole, and the thumb over the external malleolus, while the other hand steadies the lower part of the shaft of the leg. In this way, motion of the foot in all directions can be obtained and diagnostic points discovered. In every case a radiogram is to be made.

Symptomatology.—The diagnosis of fractures of the lower end of the tibia and fibula is usually not difficult. The patient will complain of severe pain in the ankle with tenderness most marked over the point of separation. Swelling occurs within a very short time and may mask other signs. Subcutaneous hemorrhage is common, and deformity, with the foot displaced outward, is usually characteristic. Abnormal mobility and crepitus are present, with complete disability in walking or standing.

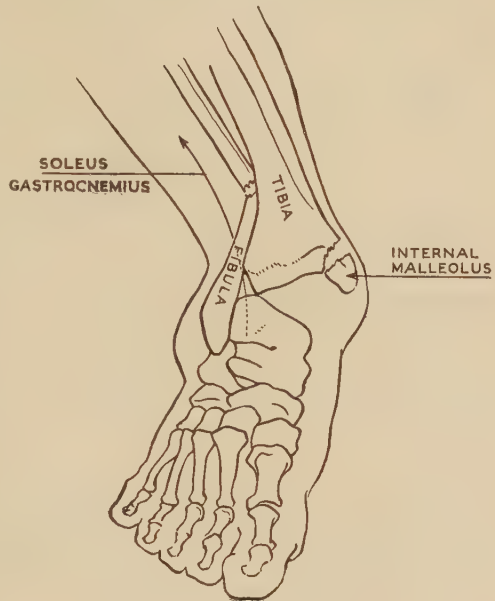


FIG. 28.—POTT'S FRACTURE.

Fractures of the Tarsal Bones

Fractures of the tarsal bones are more commonly diagnosed since the use of the radiogram. Those most frequently affected are the astragalus and the os calcis.

Fractures of the others have been described, but are very rare.

Astragalus.—Fractures of the astragalus are due to sudden dorsal flexion or forced supination or pronation of the foot. These may result from falls, blows, or crushing injuries. The separation is most common through the neck of the bone. Diagnosis is difficult because of rapid swelling and pain, slight abnormal mobility and crepitus. Therefore, the presence of such a fracture is usually only suspected,

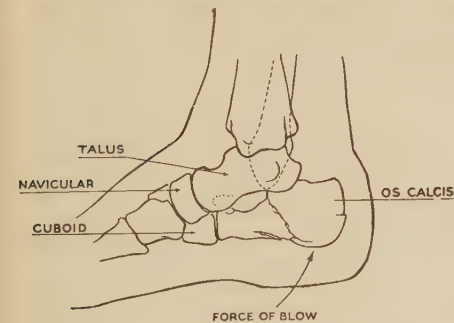


FIG. 29.—FRACTURE OF OS CALCIS.

and recourse must be had to the x-ray, to give a definite diagnosis.

Os Calcis.—Fractures of the os calcis are due in practically every case to a fall in which the patient lands in an upright position with the force on the heel. A great many variations in the fracture line may occur. Some cases show marked

impaction or separation, others merely fissures. A diagnosis is made by the history of the injury, history of pain in the heel, and tenderness, limited to both sides of the foot below the ankle and along the heel. Deformity usually consists in a *widening of the heel*; crepitus may be discovered; rapid swelling always occurs with inability to stand or walk. Arch difficulty following such fractures is almost constant.

Scaphoid.—Fractures of the scaphoid of the ankle are rare, and are usually due to direct violence or to falls upon the foot, in which the weight is received on the toes. The scaphoid is crushed between the astragalus and the internal cuneiform.

The diagnosis is made by the usual signs of fractures; the foot is commonly in a valgus position and abducted. Other signs are not definitely diagnostic and the x-ray must be employed.

Cuneiform.—Fracture of the cuneiform alone is very rare but may be associated with fractures of the scaphoid or metatarsals. The cause is usually direct violence, and the diagnosis is made by the ordinary signs of fracture, limited to this area.

Fractures of the Metatarsal Bones

Etiology.—Fractures of the metatarsal bones are usually caused by direct violence, as in dropping a heavy weight upon the foot or in being run over. Occasionally, an indirect violence sustained in jumping or dancing or making a misstep is responsible. All these fractures may be complete, incomplete, simple, or compound.

Frequency of Site.—The second toe is the one most frequently involved by direct blows; the fifth by indirect violence. The break is most common at about the middle third, often involving more than one toe. By a severe downward pressure on the longitudinal metatarsal arch there is a tendency to straighten the normal curves of the bones against the ground. Hence the second toe, being the longest and slimmest, is the one most frequently fractured.

Mechanism of Displacement.—When only one toe is fractured there is little tendency to displacement; if several are broken there is usually a pointing of the ends of each fragment toward the dorsum. The fifth metatarsal may be fractured by sudden forced inversion of the foot, as in making a misstep. Cotton explains this by stating that there is a sharp adduction of the distal end of the metatarsal bone, causing an abnormal strain at the junction of the body and base, which is held firmly to the base of the fourth metatarsal by strong ligaments.

Examination.—To examine for metatarsal fracture the two feet should be compared for deformity by inspection and palpation. On the impaired foot, localized tenderness, abnormal mobility, and crepitus should be sought. Deep palpation must be made in the long axis of the metatarsal bones and pressure exerted on the plantar surface of the foot. Finally a radiogram should be taken in every suspected case.

Symptomatology.—The signs and symptoms of metatarsal fracture depend upon the bone affected. If more than one bone is involved there is a visible deformity with the bone fragments pointing toward the dorsum. Pain is present when bearing weight on the foot or when the corresponding toe is pushed back against the metatarsus. There is often discoloration from spontaneous hemorrhage, rarely

a compound fracture, and, at times, marked swelling of the whole dorsum of the foot and toes. On palpation, localized tenderness is usually present with abnormal mobility and crepitus. In the case of an inversion fracture, the pain is usually not severe and function only partially lessened. With continued use the symptoms increase.

Complications.—Fractures of the tarsus or phalanges, compound fracture with infection, abscess or osteomyelitis, cellulitis, tenosynovitis, and injury to the blood-vessels and nerves.

Fractures of the Phalangeal Bones

Etiology.—Fractures of the toes are fairly common, and are usually due to direct violence as in crushing accidents or in the dropping of heavy weights upon the foot. At times an indirect violence as in stubbing the toe, jumping, or dancing is the causative factor.

Frequency of Site.—Any toe may be affected, but the great toe and especially its distal phalanx seem to be the most frequently fractured. The right foot is more commonly involved.

Mechanism of Displacement.—In fractures of the distal phalanx of the big toe, the fragments usually interlock and dip downward, due to the pull of the extensor tendon. An open angle on the dorsum of the toe is thus formed. Displacement in any toe may be upward, downward, or lateral, but it is exceptional to have marked deformity.

Examination.—Examination for fracture of the toe should include an examination of both feet placed side by side in plantar flexion. Deformity should be looked for and the toes of the injured foot carefully palpated for tenderness, abnormal mobility, and crepitus. Active and passive motion are then to be attempted, and walking tried. In doubtful cases an x-ray is helpful but the diagnosis can usually be made by examination alone.

Measurements are seldom necessary but can be taken from the tip of the injured toe to the external malleolus for the third, fourth, and fifth toes and to the internal malleolus from the great and first toe.

Symptomatology.—The signs and symptoms of fractures of a toe depend upon the toe affected. There is usually pain in the toe with tenderness on palpation over the point of separation. Disability may be complete or slight when an attempt is made to move the injured phalanx. Signs of injury as contusion, ecchymosis, and swelling are usually present. About the region of the fracture there is swelling of the soft tissues, abnormal mobility, and tenderness. Displacement is usually slight but may be in any direction, most frequently downward.

Complications.—Complications are compound fractures with infection, osteomyelitis, non-union, or hammer-toe from imperfect reduction.

DISLOCATIONS

A dislocation is a displacement of the articular surface of one bone from that of another with which it normally enters into the formation of a joint.

Dislocations may be classified as to degree, type, etiology, associated injuries or to individual joints.

A partial dislocation or subluxation is one in which the separation of articular surfaces is incomplete.

A complete dislocation is one in which the articular surfaces are entirely separated.

A compound or open dislocation is one in which there is an opening into the joint cavity from the external body surface.

A complicated dislocation is one in which there is a coexisting fracture, or an injury to nerves or blood-vessels.

A traumatic dislocation is one due to external violence or muscular action.

A pathologic dislocation occurs as the result of a slight trauma on a previously diseased, distended, or otherwise abnormal joint.

A congenital dislocation is one present at birth.

Dislocations are influenced not only by the direction and force of the violence but are encouraged by the shape of certain articular surfaces (ball-and-socket, hinge), age, tension of the capsule, and tone of supporting muscles and ligaments. Violence, sustained indirectly, is the most common cause; thus, by a fall upon the outstretched hand while the arm is held rigid and abducted, the force is transmitted to the head of the humerus which is driven, if the violence continues, through the articular capsule and away from the glenoid cavity. Dislocations due to direct violence are unusual, but a fall upon the shoulder has been responsible in some cases. Muscular action is a very rare cause, being an additional factor in only a few locations, *i.e.*, the humerus, patella, and temporomaxillary joint. The shape of certain joints, particularly that of the shoulder where a large humeral head rotates with a relatively small glenoid fossa, resulting in a shallow union depending largely upon soft structures for its integrity, favors dislocation.

Dislocations are rare in childhood or in old age, most of them occurring in adult males. Over 90 per cent are in the upper extremity. But any dislocation may occur at any age, if the proper violence is received. In the ball-and-socket joints the ligaments are seldom severely injured, but the greatest trauma is suffered by the capsule; in the hinge-joints, like the elbow, wrist, and knee, the ligaments are torn apart or from their point of attachment.

Dislocations of the Lower Jaw

Etiology.—Dislocation of the lower jaw is found most frequently in adults and seems to be more common in females. It is usually caused by muscular action, especially in yawning, laughing, or coughing. It commonly follows the extraction of teeth or the introduction of a large object into the mouth.

The dislocation is more often bilateral than unilateral. Forward luxation is by far the most frequent. Inward and upward dislocations are found with fractures of the skull, and backward or outward dislocation occurs only with fractures of the skull or jaw itself.

Mechanism of Displacement.—The condyle of the jaw is thrown forward by the external pterygoid muscles assisted in some cases by the pull of the temporals. By opening the mouth, the condyle advances upon the eminentia articularis, so that only a tear or relaxation of the anterior capsule is needed to allow the external pterygoid muscles to dislocate the jaw. Spontaneous reduction is prevented by the

muscular strain of the pterygoids and masseters and by the elastic resistance of the ligaments.

Symptomatology.—When a dislocation of the lower jaw has occurred there will be a history of a “slight snap” when the mouth was opened widely, with inability to close the mouth, although it can be opened slightly wider. Some pain will be felt over the joint affected and there will be difficulty in speaking and swallowing, and some dribbling of saliva. The teeth cannot be brought into contact. Exact signs will depend upon whether the condition is bilateral or unilateral. In the former type there will be an increased prominence below the zygoma on each side and an abnormal depression in front of each ear. The lower teeth will project in front of the upper. In unilateral dislocation, the jaw is thrust forward, and the chin is rotated laterally away from the side affected. There will be a slight depression in front of the ear on only one side, the mouth will be less wide open, and the lips can be brought together after a fashion. In none of these cases will there be crepitus, loss of blood or disruption of the tooth line. Dislocations of the jaw are especially liable to recurrence.

Complications.—Skull fracture.

Dislocations of the Vertebrae

Etiology.—Dislocations of the vertebrae are closely associated with fractures of the same bones as to etiology, signs, symptoms and complications. In many cases a differential diagnosis between the two lesions cannot be made without radiograms. See “Fractures of Vertebrae.” Dislocations are not uncommon, occurring most frequently in the third and fourth decades in males who are subjected to severe industrial accidents. They may be complete, or incomplete, unilateral or bilateral, forward or backward.

Frequency of Site.—These injuries are most common in the cervical region, between the fourth, fifth and sixth vertebrae, and least common in the dorsal region.

Occiput on the Atlas.—Dislocation of the occiput on the atlas is rare and fatal.

Atlas on the Axis.—Dislocation of the atlas on the axis is possible only after fracture of the odontoid process, rupture of the transverse ligament or displacement of the process beneath the ligament, brought about by a fall or blow upon the head. Death may be instantaneous or occur at any time from pressure on the cord. The head hangs loosely forward, usually without locking, the chin resting on the chest. There is a slight prominence at the back of the neck, with tenderness and signs of injury to the cervical nerves.

Cervical Vertebrae.—Dislocations below the second cervical vertebra are similar, as to cause and results, and are the most frequent of all spinal dislocations. Almost any type may be present but those most commonly found are the bilateral forward and the unilateral forward. They are caused by blows or falls on the neck or head or hyperflexion forward of a vertebra with direct pressure backward against it; rotation is an important movement in etiology. Bilateral dislocations are more frequently fatal than unilateral. In the unilateral, forward, incomplete variety with the luxation to the right, the head is tilted toward the left with a rotation and lifting of the chin toward the left. The head is held semi-

rigid with tenderness limited to the joint involved. Slight flexion and extension are possible but the lateral tilting remains. In the unilateral forward, complete type, the luxation is on the right, the head is inclined to the right while the chin is rotated slightly to the left. There is never spasm of the sternocleidomastoid muscle. The head is held semirigid with pain extending along the areas supplied by the affected nerve roots, generally in some region of the shoulder and arm. With a backward dislocation there is backward and upward extension of the head, shortening of the neck with prominence of the larynx and trachea and difficulty in breathing, swallowing or talking. The head is held semirigid with a depression at the back of the neck. Symptoms are similar to those found in the anterior dislocations and if compression of the cord has occurred, symptoms are the same as those described under fracture of the cervical vertebræ.

Dorsal Vertebræ.—Dislocations of the dorsal vertebræ are very rare, due to their position and protection by the shoulder and back muscles and the ribs. The symptomatology is similar to that for fracture of this region.

Lumbar Vertebræ.—Dislocations of the lumbar vertebræ occurring alone are rare and are usually associated with fractures.

Dislocations of sacrum never occur. Strains of the sacro-iliac joints may be a part of fracture or dislocations of the pelvis.

Dislocation of the coccyx may occur, but its importance has been grossly exaggerated; all pains in this region, many of them hysterical, are referred back to some injury, usually trivial or imagined.

Dislocations of the Sternum

Etiology.—Dislocations of the sternum are due to direct and indirect violence and muscular action, in the order named, the latter being very rare. Such an injury has been reported when the patient falls, striking on the back with an hyperextension of the sternum. At other times when the body is sharply bent forward, dislocation at this point has occurred. The injury is most common in adult men.

Frequency of Site.—Dislocation of the body forward and upward on the manubrium is about four times as frequent as a backward dislocation. Very rare cases of longitudinal separation have been reported. Dislocation of the ensiform cartilages is very uncommon.

Mechanism of Displacement.—The manubrium is held relatively fixed by the first and second ribs. The body of the sternum receives the force of a heavy blow against the chest wall and is transmitted to it from the ribs. The body is usually pushed out of the way so that it is dislocated forward and overrides the manubrium, even to the extent of an inch. The anterior ligament is torn across, the periosteum posteriorly strips up rather than tears away, and thus the structures behind it are protected.

Examination.—The sternum is examined for dislocation by inspection and palpation. Some persons normally have an exaggerated “angle of Louis” which must not be confused with dislocation.

Symptomatology.—The symptoms of a dislocated sternum may be overshadowed by a more severe injury. There will be difficulty in breathing, sharp pain at

the site of the injury, which is increased on pressure or motion of the body. The upper part of the trunk will be bent forward with depression over the upper ribs. At the point of dislocation, that is, the junction of the body and the manubrium, a shallow excavation may be palpated.

When the ensiform cartilage is dislocated there will be symptoms of point tenderness and repeated vomiting.

Complications.—Dislocations of the sternum may be complicated by fractures received at the time of the injury, those of the cervical or dorsal vertebræ, the ribs or costal cartilages being most common. Injuries to the pleural cavities or to the lung have been noted, but are very infrequent.

Dislocations of the Ribs

Etiology.—Dislocations of the ribs are the result of direct violence and are often associated with fractures of the ribs or vertebræ. They occur principally in adult males who are subjected to severe industrial injuries. The chest is crushed by a blow or fall, the force being transmitted along a rib to the point of dislocation. Hamilton believes that the action of the pectoral and abdominal muscles aids in the separation.

Frequency of Site.—Such injuries may occur at one of three points: At the costovertebral junction, at the sternal junction, or between the cartilaginous ends of certain ribs. This latter form can take place only at the anterior extremities of the eighth, ninth, and tenth ribs. All rib dislocations are rare, but the most common site is at the sternal junction of the first seven, between the rib and cartilage.

Mechanism of Displacement.—In a dislocation of a rib, there is an attempt to decrease the natural curves of the thoracic wall. If the ligaments between the articular end of the rib and the vertebral body as well as those between the rib and the transverse process give way, the rib is dislocated from the vertebra.

In an anterior dislocation, the sternocostal and interarticular ligaments are torn, the cartilage either overlying the rib or vice versa according to the direction of the force. Often several ribs are dislocated at the same time.

Examination.—To examine for dislocation of the ribs all clothing should be removed from the upper part of the trunk to allow complete inspection and palpation. Deformity should be looked for and the ends of all of the ribs palpated for abnormal mobility and tenderness. Measurements are of no value.

Symptomatology.—Physical signs and symptoms of rib dislocation depend on the site involved. In all cases there is localized pain over the point of separation, increased by coughing or deep breathing. The pain may be transmitted anteriorly around the chest, if the intercostal nerves have been damaged. On pressure, extreme tenderness may be elicited at the point of dislocation. At times a soft click (*pseudocrepitus*) is felt beneath the fingers lying over the uninjured area. Some deformity is usually obvious, and is often marked in a costochondral dislocation. At this point a subluxation is very common in adolescents; if the deformity is not present on examination, it may have reduced itself spontaneously. When a rib is dislocated from a vertebra, all the general symptoms of pain and tenderness are to be found, as well as a disappearance of the normal prominence of the rib, close to the midline of the back.

Complications of rib dislocation are rare but include perforation of the pleura, rupture of the intercostal or internal mammary arteries and possibly the formation of an hemothorax.

Dislocations of the Clavicle

Owing to the exposed position of the clavicle and to the frequency of falls and blows upon the shoulder, dislocations of the clavicle are not uncommon; when, however, we consider that the clavicle must bear the burden of any forces exerted upon the shoulder inward or forward, or of any strains which forcibly pull the arm downward, it is hardly conceivable that dislocations of this bone are not more common than they are.

Dislocations of the clavicle are divided into those of (1) the sternal end, and (2) the acromial end.

Sternal End.—*Forward Dislocation.*—This type is generally caused by a fall upon the point of the shoulder and most especially upon its anterior and outer surface, upon muscular efforts which have a tendency to suddenly and forcibly throw the shoulder backward, or in a sudden effort to balance some heavy object on the head. Rarely it occurs at birth.

As a result, the sternal end is driven forcibly inward and forward.

The signs and symptoms of an incomplete dislocation may be very slight, ranging from a slight embarrassment of the arm movements and accompanied by acute tenderness at the sternal end of the clavicle without demonstrable dislocation, to a definite but slight prominence of the sternal end of the clavicle, with the subjective symptoms which would accompany any dislocation.

If the dislocation is complete, the signs and symptoms are as follows: A more or less rounded prominence of the sternal end of the clavicle directly under the skin and encroaching upon the acromion. The shoulder of the affected side is slightly approximated toward the midline of the body. On carrying the shoulder upward, the prominence descends. If, on the other hand, the shoulder is depressed, the prominence ascends. There is impairment of all arm movements, with an acute pain especially on motion over the sternoclavicular joint. The clavicular portion of the sternocleidomastoid muscle stands out in bold relief.

Careful *measurements* from the acromial process to the midportion of the sternum show a shortening as compared with measurements on the corresponding side. Collaborators of long ago emphasized the importance of the placing of the knee against the spine and drawing the shoulders back and causing a diminution, or a complete disappearance of the sternal end of the clavicle.

Backward Dislocation.—This injury is extremely rare, and is brought about by a direct or crushing blow, but most especially by a powerful lateral compression of the shoulders.

There is a complete or partial disappearance of the sternal end of the clavicle behind the sternum. The head is inclined to the opposite side and there is an approach of the corresponding shoulder to the median line. Elevation of the shoulder may be quite pronounced with definite impairment of all shoulder and arm movements. Pain, at times of a very acute nature, is noted at the base of the neck and there may be extreme difficulty in respirations and deglutition, with partial arrest of circulation in the arm, due to subclavian pressure. There

may be venous congestion about the head. Under ordinary conditions the acromial end is slightly projected from its normal position.

Upward Dislocation.—This is an extremely rare condition. It is brought about by some force exerted upon the end and top of the shoulder.

The symptoms are elevation of the sternal end of the clavicle with a depression of the corresponding shoulder. There is a definite increase in space between the first and second rib. The clavicle encroaches more or less upon the supra-sternal fossa and causes a diminution between the end of the shoulder and the midportion of the sternum. The sternal portion of the sternocleidomastoid muscle becomes tense. An instance is described in the literature, in which the sternal end of the clavicle has been so far displaced upward as to rest upon the thyroid cartilage. Occasionally loss of speech and difficulty in respirations occur. Pain upon motion of the arm and shoulder and impairment of motion of the arm and shoulder muscles is very marked.

Dislocation of Acromial End.—*Upward Dislocation.*—This is the most frequent of all dislocations of the clavicle. It is usually due to falls on the extremity of the shoulder.

The symptoms vary in intensity with the extent of the lesion, and are either partial or complete. Signs and symptoms of a complete dislocation in this area are but an exaggeration of those of the incomplete. The outer end of the clavicle which is held by the neck muscles lies above the acromion, there being usually a rupture of the ligaments immediately investing the joint. There is a drooping shoulder and, as a rule, there is an inability to raise the arm at right angles with the body. In all motions of the arm and shoulder, the clavicle moves more freely than is normal and these motions are attended with pain at the point of dislocation. Tenderness on pressure over the site of the lesion is marked. Deformity is noted over the outer end of the clavicle. The clavicular portion of the trapezius muscle is tense and stands out conspicuously when the neck is straight. The acromion process is felt to lie below the outer end of the clavicle. When lifting the arm upward, with the hand under the elbow, the deformity decreases and may disappear, but rapidly reappears when the arm is dropped.

Downward Dislocation.—This is an extremely rare lesion and is due to external force. There is present a complete rupture of the acromioclavicular ligament.

The symptoms are as follows: There is a marked depression at the point of dislocation, with the superior angle of the scapula slightly approaching the body and the inferior angle drawn outward. Intense pain upon arm movements is noted over the site of dislocation and voluntary lifting of the arm is absent. Voluntary abduction is difficult, though the forward and backward swing is attended without much difficulty.

Subcoracoid Dislocation.—This is the rarest of all the dislocations of the clavicle and is essentially one of old age.

It is due to the relaxation of all of the ligaments.

The symptoms are as follows: There is a marked depression at the point of displacement and an elevation of the process of the scapula. The outer extremity of the clavicle is felt in the axilla. The corresponding shoulder is inclined forward and the arm motions are fairly complete, with the exception of those of

the inward and upward movements. The lower angle of the scapula assumes a slight outward and backward position, while measurements taken between the acromion and midportion of the sternum show an increase in length as compared with the opposite side.

Dislocations of the Shoulder

Dislocations of the shoulder are the most common of all dislocations, constituting about 50 per cent. They are rare in early life, and most frequently occur in adult males who are subject to industrial accidents. They are the result of direct or indirect violence, the former received as a blow or fall upon the shoulder, the latter (more common) as a fall upon the extended hand or elbow. Dislocations due to muscular action are also known.

From a practical standpoint, dislocations may be divided into: (1) Anterior (subcoracoid, subclavicular); (2) downward (subglenoid); and (3) backward (subspinous or subacromial). The dislocated humerus may be driven through the chest wall or complicated by fractures of the glenoid fossa, anatomical or surgical neck, and greater or lesser tuberosity.

Examination for dislocation of the shoulder should begin by ascertaining the history of the injury; how received; the position of the shoulder and arm at time of accident; and the position of arm immediately after the accident. Inspection should be carefully made for signs of injury and deformity. Of greater importance is the examination of the shoulder. Many times the change in the curve of the shoulder will suggest the diagnosis. The shoulder should then be palpated for deformity and tenderness, and the axilla palpated for the presence of the humeral head. Active motion of the arm may be attempted, followed by gentle passive manipulation. With one hand in the axilla the rotation of the humeral head should be noted when the elbow is moved. Finally, a radiogram should be made in order to determine the exact site of the head of the humerus.

Shoulder Injury Tests.—*Hamilton's Ruler Test.*—If a ruler can rest against the external condyle and the acromial process at the same time, there is either a dislocation of the shoulder or a fracture of the neck of the scapula. Normally, the greater tuberosity prevents a ruler resting against these two points simultaneously.

Calloway's Test.—A dislocation of the shoulder is revealed by measuring the circumference of the shoulder by passing a tape over the acromial process and down through the axilla. This is especially useful in fat persons; an increase in the girth of the shoulder as compared with the normal side indicates dislocation. Soft tissue swelling should not be confused with bony displacement.

Dugar's Test.—A dislocation of the shoulder is revealed by an inability to place the elbow against the body when the hand is placed on the opposite normal shoulder.

Bailey's Test.—A dislocation of the shoulder is disclosed by a comparison of the triangle composed of the three bony points of the shoulder with a similar triangle on the opposite side. The points of this triangle are the tip of the coracoid process, the tip of the acromial process and a fixed point on the greater tuberosity.

Anterior Dislocation.—*Subcoracoid Dislocations.*—A subcoracoid dislocation is the most frequent of all the dislocations of the shoulder and is due to the same general causes as noted above. The head of the humerus rests in the middle anterior position, at the anterior surface of the neck of the scapula and beneath the conjoined tendon of the coracobrachialis muscle. Forced abduction with muscular contraction is present but inward rotation is rare.

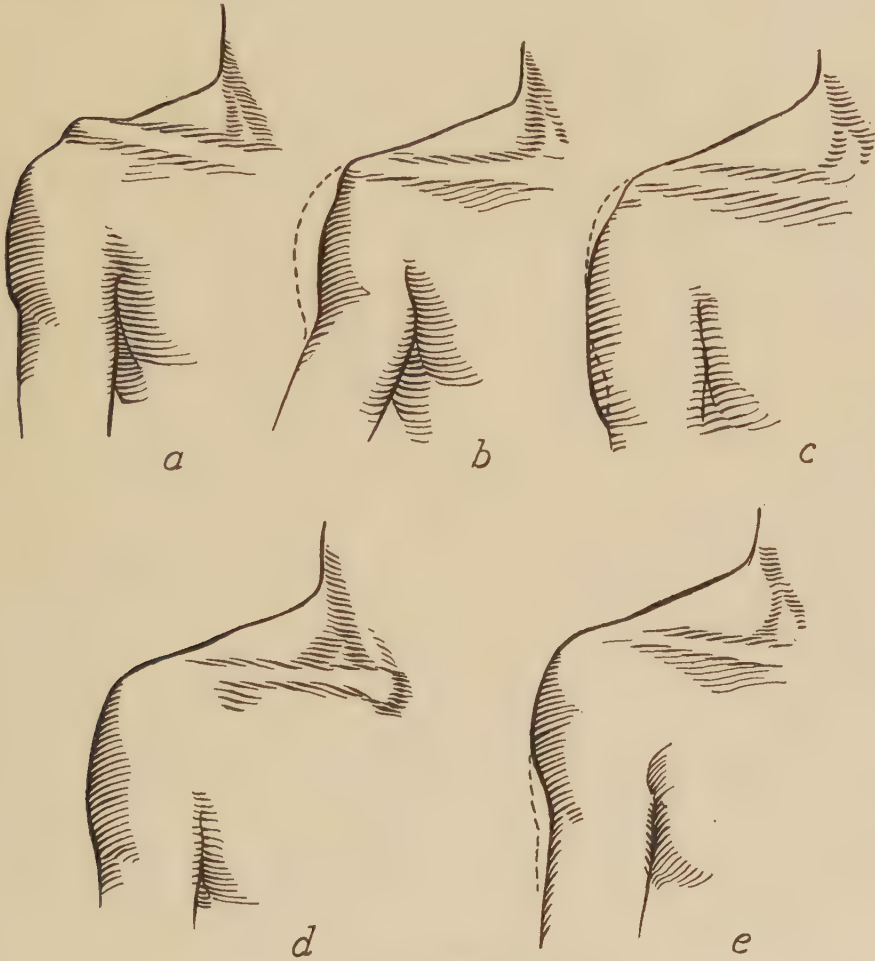


FIG. 30.—SHOULDER CONTOURS.

(a) Dislocation of acromial end of clavicle; (b) anterior dislocation of humerus; (c) fracture of neck of scapula; (d) dislocation of sternal end of clavicle; (e) fracture of neck of humerus.

Examination is similar to that just outlined and *measurements* from the acromial process to the external condyle will show a slight increase in the length of the arm.

The signs and symptoms of subcoracoid dislocation are: The presence of the head beneath the coracoid process causes fullness, because it lies deep in the anterior margin of the axillary fossa. The head is missing from the axilla. The outer contour of the arm is in the shape of an obtuse angle. The shoulder is distinctly flattened. The arm is practically useless; all motions are painful and

restricted. It is impossible to bring the arm to the side or to place the hand of the injured arm on the opposite shoulder. The axis of the humerus, as seen from the front, projects toward the clavicle, that is, medial to its normal position. There is absolute loss of adduction of the arm. When the elbow is rotated, a mass may be felt near the coracoid process.

Subclavicular Dislocations.—Subclavicular dislocations are the most extreme of the anterior displacements, the head resting just below the clavicle upon the chest wall. The condition is unusual and corresponds for practical purposes to a subcoracoid dislocation.

Downward Dislocations.—*Subglenoid Dislocations.*—A subglenoid dislocation is a downward displacement caused by violence, *e.g.*, direct blows on the top of the shoulder, falls upon the extended hand or elbow or by violent abduction. This condition closely simulates a subcoracoid dislocation but the *humeral head can be palpated in the axilla*. The head is displaced by a pressure upon the joint-capsule in front of the long head of the triceps, until the capsule ruptures and the head descends to the inferior edge of the scapula. The head rests upon the subscapular muscle which is often torn from its attachment to the humerus (the lesser trochanter). The shoulder is markedly flattened and the axis of the humerus projects below and to the inner side of the glenoid fossa. The *arm is apparently lengthened*, as shown by measurement from the acromial process to the external condyle. The arm is more abducted than in the subcoracoid variety. Of great diagnostic importance is the increased prominence of the humeral head in the axilla.

Backward Dislocations.—*Subspinous or Subacromial Dislocations.*—Subspinous or subacromial dislocations are rare. They are due to the same causes as other shoulder dislocations, but in this type, the head escapes through the posterior portion of the capsule. The shoulder appears broader than normal; the elbow is displaced considerably forward with the axis of the arm directly backward. The arm is adducted with inability in abduction. The coracoid and the acromial processes are prominent and the head of the humerus can be palpated below the acromion of the scapular spine.

Complications of dislocations of the shoulder are fractures in the shoulder region, especially the tuberosities, acromial or coracoid processes, rupture of the biceps tendon, injury to the axillary vessels, damage to the brachial plexus, ankylosis or redislocation.

Dislocations of the Elbow

Dislocations of the elbow may be of several varieties. The vast majority of them are caused by falls on the elbow or falls on the outstretched hand, so received that the arm forced into hyperextension or in partial extension is driven forcibly upward. These dislocations are the third most common of all dislocations, only those of the shoulder and fingers being more frequent. They are found especially in children and young adults rather than in old age, and more often in males.

Both bones of the forearm may be dislocated, backward, forward, outward, inward or divergently. The radius or ulna may be displaced alone. The radius, as a rule, is directed forward, backward and outward while the ulna usually travels back-

ward and upward. Dislocation of both bones backward is the most common injury. Lateral displacement is much less frequent, while the forward variety is very rare. Isolated dislocation of the radius is more common than that of the ulna. Compound injuries are rare.

Backward dislocation of the radius and ulna is caused by an hyperextension sufficiently great to tear the capsule in front, followed by a forcible backward pressure with the forearm slightly abducted. This is brought about usually by a fall on the palm of the extended forearm. The internal lateral ligament is always torn and the external lateral usually gives way, depending upon the amount of violence received. This same injury may be caused by a severe blow on the back and lower part of the humerus or possibly by a very severe twisting of the forearm.

Examination for dislocation of the elbow will need only inspection, palpation and comparison with the normal elbow, unless several hours have elapsed from time of accident when swelling may obscure diagnostic signs. Deformity should be looked for and then the elbow region palpated to determine bony landmarks, abnormal mobility and crepitation. Active and passive motion may be attempted and radiograms should be made.

Measurements are seldom necessary but are of value. The distance from the acromion to the condyle of each arm will be the same but a measurement from the internal condyle to the styloid process of the ulna of the injured arm will show shortening. The same result may be obtained by measuring from the acromion to the styloid process.

When the forearm is dislocated backward, it is held semiflexed at 130 to 140 degrees, in an obtuse angle, with the hand midway between supination and pronation. The anteroposterior diameter of the elbow is increased by a prominence of the lower end of the humerus in front and a projection of the radius and ulna in back of the joint. This projection of the olecranon is very characteristic and diagnostic. There is severe pain in the elbow increased by motion. Swelling appears early and may mask important signs. Both flexion and extension are possible to a very small extent. Flexion is often prevented by the impinging of the coronoid process against the humerus. Lateral motions are increased, there is marked muscle spasm and the forearm appears shorter. The epicondyles are moved anterior to the olecranon whereas in supracondyloid fracture of the humerus this relation remains normal. The axis of the humerus is directed in front of its normal position, pointing toward the middle of the forearm rather than toward the joint. Traction on the forearm will not cause the deformity to disappear. Above the prominence of the olecranon, there is a concavity which is increased by flexion of the forearm.

Forward dislocation of the radius and ulna is very rare but has been caused by a fall on the flexed elbow, with the forearm thrust forward, or by a blow on the olecranon. There is often an associated olecranon fracture.

The prominence of the olecranon will be missing from the back of the elbow.

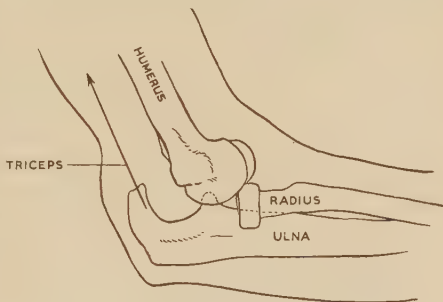


FIG. 31.—BACKWARD DISLOCATION OF ELBOW.

If the forearm is found extended, the olecranon lies in front of the joint; if flexed, the end of the olecranon rests above and in front of the condyles. There may be some lateral displacement combined with the forward dislocation. At the back of the elbow the lower end of the humerus is prominent. There will also be the usual signs and symptoms, *i.e.*, pain, tenderness, limitation of motion and swelling.

Outward dislocation of the elbow is fairly common, being either incomplete or complete, with or without pronation. It may be due to direct injury or a fall on the hand when the forearm is extended, but more often it is caused by a forcible adduction of the forearm. The internal lateral ligament is always torn.

In the incomplete variety which is more common, the head of the radius is seen and felt on the outer side of the external condyle. The concave surface of the olecranon rests in a groove between the capitulum and trachea. Pronation and supination may be practically normal and flexion and extension only slightly limited. The skin may be tightly stretched over the trochlea whose lower inner edge forms a sharp projection, running forward and backward near the internal condyle, an important finding. The elbow is greatly broadened from side to side.

In complete outward dislocation of the elbow the measurement from side to side will be twice the normal. This type is much less common. Pronation may be impossible or the hand is found already pronated with the front of the forearm facing downward and inward; the arm may be slightly flexed and the forearm adducted. All the articular surface may be felt, the olecranon and head of the humerus lying above and to the outer side of the external condyle. The usual signs and symptoms of dislocation will also be present, including pain, loss of function and swelling.

Inward dislocation of the elbow is rare and always incomplete. The lateral ligaments are torn, the anterior ligament often giving way, too. There is nothing definitely characteristic in the deformity; the olecranon projects beyond the epitrochlea, the olecranon fossa being palpable and empty, while in front of it or behind and below it lies the head of the radius. Flexion and extension may be but slightly limited but the elbow will be greatly widened and pain and swelling are prominent.

Divergent dislocation of the radius and ulna is very uncommon and due to extreme violence. Two forms are recognized. The first, the anteroposterior, in which the radius is dislocated forward and the ulna backward; the second, the transverse, in which the radius goes outward and the ulna inward with the whole width of the humerus between. The diagnosis is usually easily made by inspection and palpation. The first variety resembles a backward dislocation; the second is so rare as to be a curiosity of surgery. The elbow is extremely widened with the olecranon found to the inner side of the internal condyle and the radius outside the external condyle. Between the two is the intact humerus so that crepitus is not present but pain and swelling and limitation of motion are the chief complaints.

Dislocation of the ulna alone is usually backward, very rarely forward or inward and is due to severe pronation and adduction or a fall on the ulnar side of the hand or forearm. The backward type is a rotary luxation upward, backward and outward, using as a pivot the head of the radius which is practically undis-

turbed. The coronoid process is forced beyond the trochlea, either completely or incompletely. The arm is held in full or practically full extension with flexion impossible. The olecranon is very prominent, being above a horizontal line through the epicondyles. There is shortening of the forearm along the ulnar side similar to a "gun-stock" deformity. The general symptoms resemble those of posterior dislocation of both the radius and ulna.

Forward dislocation of the ulna is one of the rarest dislocations. The arm is held at a right angle with a fair degree of motion still possible. Mobility, laterally outward, is increased. There is an abnormal abduction of the forearm which can passively be increased.

Dislocation of the radius alone is more common than that of the ulna, and is due to direct blows or falls. The displacements may be forward, backward or outward. It commonly follows direct violence, torsion or falls on the pronated hand.

Forward dislocation is usually incomplete, the result of the muscular action of the biceps. The head of the radius is missing from its normal position in relation to the bony points at the back of the elbow and instead is found projecting forward above the capitulum. Posteriorly there is a depression where the head of the radius should normally be felt with an abnormal convexity in the region of the supinator muscles. There is slight pronation and flexion of the forearm with a shortening of the radial side, active supination is impossible and flexion cannot be carried beyond a right angle. This injury is frequently complicated by a fracture of the upper third of the ulna.

Backward dislocation of the radius is extremely rare, but it may occur from a direct blow or as the result of a blow transmitted upward from the hand, the elbow being flexed, or the forearm in a position of forced pronation. Such a displacement may be recognized by finding the radial head posterior to its normal position, just behind the external condyle. Its articular surface may be palpated. The olecranon is in its normal position. The forearm is fully or partially pronated in extension or very slight flexion. There is marked limitation of supination, and some difficulty in flexion and extension.

Outward dislocation of the radius is very uncommon, occurring as the result of direct pressure upward along the radius when the elbow is flexed and fixed. The signs and symptoms resemble closely those of backward dislocation.

Subluxation of the radius (Malgaigne's luxation), or *pulled elbow*, is common in children under four years of age and is the result of lifting the child by the forearm, or pulling on it. The head of the radius is drawn upward from beneath the articular ligament and then forward by the biceps. There is no visible deformity, little or no swelling, often no palpable displacement although in some cases a separation can be felt between the radius and the humerus. The child refuses to use the arm or have it touched; while it remains quiet by the side or supported by the other hand there is no pain. Motion of the elbow or forearm, especially supination, is painful and tenderness is present on pressure over the head of the radius. There is partial flexion of the elbow with pronation of the hand. Flexion and extension are nearly normal. On forced supination a click is heard, and the arm is used normally again.

Complications.—Dislocations of the elbow may be complicated by fractures about the joint, occurring either at the time of the accident or during the process of

reduction. The internal epicondyle may be forced into the joint or the biceps tendon may be caught behind the external condyle and lacerated. The brachial vessels may be torn or the median, musculospiral or ulnar nerve may be injured.

Dislocations of the Wrist

Dislocations of the wrist may involve the lower radio-ulnar joint, the radiocarpal joint, the carpal bones, or the carpometacarpal joints. Injuries to the wrist are very common but simple dislocations are very rare, the severe trauma usually resulting in fracture.

An *examination* for the detection of a dislocation of the wrist should begin with a history of the accident, how sustained, direction of blow or fall, and the position of wrist when violence was received and immediately afterward. Inspection should be made of both volar and dorsal surfaces for evidence of trauma, such as abrasions and ecchymosis, swelling and deformity; this should be followed by careful palpation to determine tenderness, deformity and abnormal mobility. Active motion will probably be very limited because of pain, and passive movements should be gentle. If no radiographic examination can be made for one reason or another, passive motion may be tried under an anesthetic, at which time or later, reduction is accomplished.

Lower Radio-Ulnar Joint.—Dislocations of the lower radio-ulnar joint are usually associated with fractures about the wrist but the isolated dislocation is rare. The injury follows a fall upon the front or back of the hand or the lower end of the ulna; the resulting displacement is, as a rule, forward but may be backward, brought on by the direction of the violence. The lower end of the ulna is found projecting either forward or backward with a depression on the opposite surface. A radiogram should be made so that an associated fracture, which is so frequent, will not be overlooked.

Radiocarpal Joint.—Dislocation of the radiocarpal joint is uncommon but may result from a fall upon the hyperflexed or hyperextended hand which causes a backward or forward displacement. The former variety resembles a 'Colles' fracture but the prominence of the front of the wrist extends farther down toward the palm. There is a prominence at the back of the wrist where the carpal bones may be outlined. In the latter variety, the forward, there is a depression on the back of the wrist where the lower ends of the radius and ulna can be palpated and a prominence on the front of the wrist caused by the carpal bones.

Intercarpal Joint.—Dislocation of the intercarpal joint, that is, one row of carpal bones upon the other, is very rare. The few cases reported have been caused by a fall upon the hand and have resembled a 'Colles' fracture except that the deformity was a little nearer the hand. There was a thickening of the wrist with tenderness and loss of extension and abduction.

Carpal Bones.—Dislocation of the carpal bones is unusual but of importance. The semilunar and scaphoid are the two most frequently affected but any bone may be displaced.

The *semilunar*, when dislocated alone, is pushed anteriorly by severe violence on the extended wrist. Just anterior to the lower end of the radius, a small mass may be found beneath the flexor tendons. The palm appears shortened, while any

motion of the partially flexed fingers is painful. There is a silver-fork deformity, nearer the hand than in Colles' fracture, the posterior prominence being caused by the os magnum with a depression between that bone and the radius. This depression is normally filled in by the semilunar. The styloid processes of the radius and ulna are in normal relation but the distance from the ulnar styloid to the base of the first metacarpal is shortened. Radiography should be employed to give the exact diagnosis.

Dislocation of the *scaphoid* or navicular follows forced palmar flexion of the hand and is usually backward, either partial or complete. The dislocated bone can often be palpated on the dorsum of the hand, on the inner side of the tendon of the long extensor of the thumb. In the cases reported, there has been only slight interference with function.

Dislocation of the *os magnum* or capitatum has been caused by striking the dorsal surface of the wrist against the ground and causing an extreme flexion of the wrist so that the fingers touched the forearm. A hard mass becomes prominent on the dorsum of the wrist at the base of the third metacarpal bone. The hand is held semiflexed, extension causing pain but otherwise little disability.

Dislocation of the Carpometacarpal Joints

Dislocations of the carpometacarpal joints are very rare but have been reported following severe direct blows. The thumb is most frequently affected and is injured by striking an object with the fist when the hand is relaxed, the ulna being flexed and partially supinated so that the force of the blow is received on the base of the first metacarpal bone. Such an injury is found most commonly in drunkards. Similar dislocations of the other fingers may occur in the same way but are usually associated with fracture of the base of the bone.

The displacement is most commonly in a backward direction because of a tearing of the posterior portion of the joint-capsule. The force of the blow lands on the distal end of the metacarpus, forcing it inward, and the muscles of the thumb, particularly the abductor pollicis and flexor pollicis brevis, contract and, held by the clenched fist as a fulcrum, force the base of the metacarpus to an outward and backward displacement.

Examination when a carpometacarpal dislocation is suspected must include inspection and palpation of all bony landmarks with careful comparison with the normal hand. Active and passive movements of each finger in all directions must be attempted.

Such a dislocation may not be noticed immediately after the injury because the pain is slight and function but little impaired. A few hours later or the next day, the thumb is weak and on clenching the fist, the flexor tendons may not act as before in forcing the base of the thumb out. The joint may be felt to repeatedly slip, the dislocation being easily reduced but readily recurring. In dis-

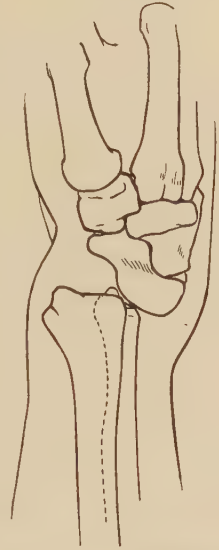


FIG. 32. — BACKWARD DISLOCATION OF CARPUS.

location of the other fingers, a bony mass is to be found in the palm at the site of dislocation, while on the dorsum of the hand the knuckle will be replaced by a depression. All of these dislocations are especially liable to recurrence.

Metacarpophalangeal Joints.—Metacarpophalangeal joint dislocations are caused by severe blows and by hyperextension. The thumb is fairly commonly involved, the other fingers relatively less so. The first phalanx is displaced upward and backward behind the rounded head of the first metacarpal, having torn through the anterior part of the capsule. In the classical position the head of the metacarpal bone is "buttonholed" between the outer head of the flexor brevis and the tendon of the flexor pollicis longus. An incomplete dislocation may occur.

Examination for such a displacement must include inspection and palpation and careful comparison with the opposite, normal hand. Measurements are not of great value but abnormal relations can often be made out by a study of the skin folds formed by the joints and by a comparison with the normal.

The *symptoms* of metacarpophalangeal joint dislocations are tenderness over the joint, swelling, and loss of function. The deformity occurs in two degrees. In the first, the proximal phalanx is hyperextended, the distal phalanx sharply flexed and the whole finger abducted. The base of the phalanx is palpable on the dorsum of the hand while the head of the metacarpal is prominent at the distal edge of the thenar eminence. If the ligaments are not torn, the finger will be rigid. In the second degree of displacement, reduction has been attempted but unsuccessfully. The phalanx is brought down parallel to the metacarpal bone without reducing the dislocation. The deformity at the joint itself is increased. The complications are fractures of bones or tearing of ligaments, causing subsequent finger weakness.

Phalangeal Joints.—Dislocations of the phalanges occur from direct or indirect blows and may be backward, forward or lateral. They are not common but the backward type is most frequently encountered and is caused by hyperextension. The forward variety follows forced flexion of the last joint when the second joint is extended or hyperextended. About the last joint, the insertion of the flexor and extensor tendons is indistinguishable from the capsule itself. When the capsule gives way, the tendon may be torn and serious injury sustained. Examination requires only inspection and palpation. When such a dislocation occurs there is pain over the joint, loss of function of extension or flexion, and an obvious deformity. The forming of a diagnosis is not difficult.

Complications are fractures of bone and tearing of ligaments.

Dislocations of the Pelvis

Etiology.—Dislocations of the pelvis may involve the sacro-iliac joints, the symphysis or the coccyx. All of these are rare, the bones usually fracturing before the joints separate. Such injuries follow severe trauma; mining accidents with the caving in of ground are especially frequent causes. They result from crushing injuries in which the pelvis as a whole is compressed anteroposteriorly or laterally. They occur in many automobile accidents, collapse of buildings and in accidents while in the saddle. During labor the symphysis alone may be forced to separate.

Frequency of Site.—The actual separation seldom takes place through the cartilage itself but rather between the cartilage and the bone. Dislocation of the coccyx is extremely rare. Separation of the symphysis is perhaps slightly more common. Dislocation of the sacro-iliac joint is a frequent diagnosis but it is seldom possible to demonstrate definite separation.

Examination.—With a severe injury the patient is usually found lying in the dorsal decubitus position, with hips and knees semiflexed. In this position, by making pressure upward in the direction of the femur, the patient will frequently complain of pain localized over the point of dislocation. Inspection will seldom give positive signs, but valuable information will be gained by compression of the pelvic bones anteroposteriorly and laterally. In this way abnormal mobility and points of tenderness will be elicited. See "Fractures of Pelvis."

Symptomatology.—The diagnosis of sacro-iliac dislocation is made many more times than actual pathologic separation can be demonstrated. The symptoms may be so varied in extent and degree that this term has been used to cover a variety of conditions. The actual dislocation is very rare, but occurs most frequently with an anterior fracture of the pelvis. It is an interesting fact that in severe cases associated with fracture the sacro-iliac dislocation seldom gives rise to marked pain. But it is the slight injury, with no demonstrable findings, which gives troublesome symptoms. The patient complains of pain in the lower back and over the joint increased on movements as in bending or walking. Pain is apt to persist even when resting, but is more severe when motion is attempted. In some cases there are associated neuralgic pains and paralysis of the leg, from injury to the sacral plexus; this is unusual. With backward dislocation there may be apparent shortening of the leg, the ilium moving posteriorly and upward. With forward dislocation the anterior superior spine projects abnormally and the pelvis is broadened.

When the symphysis is dislocated, there is localized pain over the pubis with abnormal mobility of the joint especially noticeable on direct pressure and forced abduction of the thighs. In some cases ecchymosis is prominent. It is very rare to have a separation sufficiently wide to be palpable. The patient is unable to stand erect because of the pain and the sensation of lack of support in the pubic region.

Dislocation of the coccyx, the only true dislocation of the pelvis, is very rare. Such an injury follows blows or falls upon the anal region. Excessive pain in the region of the coccyx is complained of, made worse upon sitting down or upon defecation. Frequently there are associated general nervous disturbances which are distressing to the patient. Diagnosis is made by rectal palpation and the radiogram.

Complications.—Complications of dislocated pelvis are very unusual. There may be rupture of the bladder or urethra or injury to the rectum, iliac artery, veins or sacral plexus.

Dislocations of the Hip

Dislocations of the femur or hip joint occur only in severe injury in which the bones withstand fracture and allow the joint to be disrupted. They are sustained by falls when the leg is flexed and abducted, or by a weight falling on the

back while bending over. Men are more commonly affected than women, especially young and adult men who are exposed to severe industrial accidents.

There are several types of dislocation but practically they can all be classed as either *anterior* or *posterior*. The exact diagnosis depends upon the position of the femoral head in its relation, anteriorly or posteriorly, to the plane of the Y-ligament of Bigelow. Posterior dislocations are upward and backward in the relation of the femoral head to the *dorsum ilii*. Anterior dislocations are downward to the obturator foramen or inward toward the pubes.

The head escapes through the weakest portion of the capsule, that is, through the posterior part, since the Y-ligament gives strength anteriorly. When the head is free from the joint it may take up any one of several positions, depending upon the force and direction of the injury and subsequent manipulation of the leg. The strong iliopsoas muscle group tends to draw the femur upward toward the trunk but the strong Y-ligament prevents greater displacement.

To examine for a dislocation of the hip the patient should lie on the back with legs and lower trunk fully exposed. Shortening, eversion or inversion of the legs are looked for and the normal resistance of the head of the femur in the groin palpated. Then active and passive motions of the thigh should be carefully attempted while the examiner's hand seeks to determine the position of the femoral head. If the leg is inverted, the head behind the acetabulum and beneath the glutei, a *dorsum ilii* dislocation is present; if the head is indistinct and only slight motion is possible, the head is probably in the sciatic foramen; if the leg is flexed and adducted within the head above the ischial tuberosity, a *tuber ischii* type is diagnosed. If the leg is everted with the head under the adductor muscles it is probably against the thyroid foramen; if on the pelvis, filling in the hollow in the groin, there is a pubic dislocation; if beneath Poupart's ligament and near the anterior inferior iliac spine, the dislocation is subspinous. These are the most frequent varieties.

Measurements are not of value because the distance from the anterior superior iliac spine to the malleoli is increased in some cases, decreased in others.

Posterior dislocations of the hip are relatively common and result from crushing injuries, falls and especially caving in of excavations. There must be inward rotation of an adducted partly flexed thigh or a severe direct backward thrust. The inward rotation is the most important factor because by its means the head of the femur is forced downward and backward against the capsule. It is in this lower part of the joint that the capsule is most frequently found torn. After the head escapes from the joint-capsule it may go in any direction, but most commonly it is directed posteriorly.

The signs and symptoms of posterior dislocation include flexion of the hip and knee with adduction and apparent shortening. There is marked inversion of the foot, the toes often resting on the *dorsum* of the opposite foot. Flexion is greatest when the head is low down and since flexion and inversion are controlled by the tension of the Y-ligament their extent depends on the distance of the head from the joint cavity. The patient is unable to walk or stand on the involved leg. There is definite limitation of extension, abduction and outward rotation, but flexion, adduction and inward rotation can often be increased. There is a loss of prominence of the trochanter and the normal depression behind it;

the trochanter lies above Nélaton's line. The gluteal fold on the affected side is higher than normal.

Anterior dislocations of the hip joint are pubic, reversed thyroid, obturator or perineal and result from forced abduction and extension of the leg. The obturator form is next in frequency after the dorsal. The capsule is torn below and in front but the tear is limited anteriorly by the Y-ligament.

The diagnosis of an anterior dislocation is made by finding the leg partially or completely extended with a varying amount of abduction. Walking may be possible but difficult, painful and awkward. The leg is rotated outward, and adduction and internal rotation cannot be made. The subclasses of anterior dislocation cannot be divided clinically. In the pubic type, there is apparent lengthening of the leg. Active motion of the thigh is impossible. The normal site of the trochanter is hollowed out and the gluteal region flattened.

Central dislocations of the femur involve fracture of the base of the acetabulum with a forcing of the humeral head into the pelvis. Such an injury is not common. The head may be palpated through the rectum. X-ray will give the exact diagnosis.

Complications of hip dislocation include fracture of the femur, pelvis, rim of the acetabulum, injury to the sciatic nerve, tearing of muscles, especially the obturator internus and externus, piriformis, quadratus and even the gluteus maximus. By excessive stretching, the adductors, pectineus, gracilis and gluteus maximus may be torn. The anterior crural nerve has been injured with resulting anesthesia and slight temporary or permanent muscular atrophy.



FIG. 34. — ANTERIOR DISLOCATION OF HIP.



FIG. 33. — BACKWARD DISLOCATION OF HIP.

Dislocations of the Knee

Dislocations of the knee are caused by violent force or falls. The displacement may occur forward, backward, inward, outward or by rotation, and it may be either complete or incomplete. All such injuries are rare but the forward is the most common. This is usually sustained by the trunk and thigh falling forward when the leg is flexed. There is a rupture of the lateral ligaments and either a breaking of the

strong posterior ligament or its separation from the tibia. The lower end of the femur rides on the posterior proximal surface of the tibia. Dislocation of the fibula alone is very rare; outward and forward displacement has been described.

Examination for dislocation of the knee should cover carefully the relations of the bones of the knee to each other and a comparison with the normal leg. Projection of any bone should be noted. Examination for apparent or real short-

ening of the leg should be made. Then active and passive flexion and extension of the knee should be attempted.

With a forward dislocation of the knee the deformity will be obvious. The leg is usually extended and shortened. The condyles are posterior and inferior, while the head of the tibia is anterior and superior. The quadriceps femoris is lax but whole; the patella freely movable. The condyles are prominent in the popliteal region where they may exert so great a pressure that the circulation below is impeded and edema develops.

In backward dislocation, the displacement is not as great and shortening is not as marked. The head of the tibia is superior and posterior, the condyles inferior and anterior. In outward dislocation the inner tuberosity of the tibia is on the outer condyle of the femur. Such a dislocation is usually incomplete.

The leg is partially flexed without shortening. The inner condyle projects internally and medially with a depression below it. The head of the fibula projects laterally and externally with a depression above it.

Inward dislocation is also usually incomplete and is just the opposite from the outward type.

Dislocations of the knee may be complicated by fractures or by injury to the nerves or blood-vessels. There may be anesthesia or paralysis from pressure on the internal popliteal nerve or gangrene of the leg from compression of the popliteal artery.



FIG. 35.—OUTWARD DISLOCATION OF PATELLA.

Dislocations of the Patella

Dislocations of the patella result from direct or indirect violence, the former being received as blows or falls, the latter by muscular exertion. Those who are knock-kneed or whose external condyles are not as prominent as normal are especially liable to suffer from an outward dislocation. This may be caused also by a sudden inward twisting of the thigh while the leg is turned outward and the weight of the body resting upon the foot. Falls

in which the knee is turned inward and the foot outward favor this same injury as do direct blows on the inner or outer margin of the patella. Predisposing factors are abnormal mobility of the patellar ligament or tendon of the quadriceps femoris.

An outward dislocation is by far the most frequent, being followed by the inward and rotatory types. All others are exceptionally rare.

If the bone is dislocated by a direct blow, the mechanism is a simple straight force. When muscle action comes into play there is, by a sudden contraction, an attempt made by the muscle to occupy a straight, and most direct line from origin to attachment. If the knee is partly flexed and the leg twisted laterally there is a tendency for the patella to be thrown sideways and dislocated. A locking over the condyle prevents spontaneous reduction.

Examination for a patellar dislocation must cover inspection and palpation of the injured knee and comparison with the normal. Inspection alone is often sufficient but palpation is easily performed and the diagnosis made more certain. Concomitant fracture must not be overlooked. X-ray is seldom necessary.

The symptoms are practically the same for all types of patellar dislocations, but the signs may vary considerably. The leg is useless, with inability to walk or stand. There is pain in the knee and tenderness when palpating the patella. The knee is found partly flexed with further flexion impossible. Passive extension can be made, but active extension is lost. The normal place for the patella is empty while the bone is held to the outer or inner side of the knee joint, depending upon the type of dislocation, by the quadriceps and patella tendons. The knee is increased in width and is flatter than normal with a visible intercondyloid notch. After a short time, effusion into the joint may obliterate some of the earlier signs. There may be a dimple in the skin over the patella because of the close attachment of the integument to the bone. This sign is prominent in rotatory dislocation.

Complications are accompanying fracture about the knee, recurrent dislocations, rupture of ligaments, and injuries to the knee joint leading to arthritis.

Dislocations of the Ankle

Dislocations of the ankle are the results of severe injury and twisting. They are often complicated by Pott's fracture or other fractures of one or both bones of the leg. All such dislocations are rare, comprising about $\frac{1}{2}$ per cent of all dislocations. The backward type is most common; forward very rare; and of the laterals, the outward is more frequent. Uncomplicated dislocations of the ankle are rare because of the deep mortise of bone and the strong ligaments surrounding the joint.

Examination for ankle dislocation should cover a careful study of the relative positions of the bony points by inspection and palpation. The relative position of the foot to the ankle should be considered and reference to the normal foot be made. Displacement to one side, forward or backward should be noted. Then active and passive motion should be attempted.

If desired, but seldom necessary, measurements may be taken from the external malleolus to the base of the fifth metatarsal bone, to the tip of the great toe or to the end of the heel; from the internal malleolus to the tubercle of the scaphoid; from each malleolus to the sole of the foot.

Backward dislocation of the ankle is sustained by a forceful fall backward when the foot is flexed, and is usually accompanied by fracture of the tibia and fibula. There is pain and swelling of the ankle with loss of motion. The foot is shortened; the heel appears longer and more prominent. There is a prominence of the tibia over the dorsum of the foot so that the articular edge of the tibia may be palpated. The tendon Achilles is clearly visible, often being taut. The malleoli are in normal relation to each other but are too far forward; that is, too far anterior to the heel.

Forward dislocation is caused by a forceful dorsal flexion of the foot. The heel is less prominent and is pushed forward so that the foot appears lengthened. The articular surface of the astragalus can be palpated anterior to the end of the tibia. The malleoli are in normal relation to one another but are nearer the heel.

Lateral dislocations are very rare without fracture of the malleoli, outward

displacement practically never occurring without fracture of the fibula. Here the foot is found abducted, the toes pointing outward while the outer border of the foot is lower and the inner edge turns upward.

Inward dislocation occurs with rotation, and is usually accompanied by fracture of the fibula or internal malleolus or laceration of the internal lateral ligament. The foot is turned in, adducted, and the inner border lower, while the outer edge is turned upward.

Complications of ankle dislocations are fractures sustained at the time of the injury and interference with the nerve and blood supply which may lead to gangrene of the foot.

Dislocations of the Toes

Dislocations of the toes are rather common, being usually due to indirect violence sustained in twisting or tripping or kicking, which causes a forced hyperextension. A patient has recently been seen who sustained a dislocation of the metatarsophalangeal joint, second toe, by slipping while barefoot on the tile floor of a swimming pool. Rarely is this injury the result of a direct violence received as a blow or object falling upon the foot.

The distal joint of the big toe and the metatarsophalangeal joint of the same toe are the ones most commonly affected. Any joint of any toe may be dislocated singly, or several may be injured at the same time.

The mechanism of the toe dislocation is not complicated. The blow or force is received on the distal extremity of the toe so that the phalanx is pulled upward by the extensor tendon. The displacement may also be backward or to one side; rarely it is compound.

Examination should cover inspection and palpation with a comparison with the normal foot. Deformity, tenderness and abnormal mobility must be looked for. A radiogram should be taken in every doubtful case.

The signs and symptoms of toe dislocation vary with the site of injury. The disability may be slight, a mere limp; or more severe, a total inability to stand on the affected foot, caused chiefly by the ensuing pain. Deformity is the result of soft tissue swelling, as much as by any bony displacement. The involved edge of the dislocated bone can be palpated, abnormal mobility is very slight and crepitus absent. Contusion and ecchymosis may be prominent over the site of dislocation, particularly in those due to direct violence.

Complications of toe dislocation are fractures of the foot or toes, and compound fractures with infection and osteomyelitis.

CHAPTER XIII

ARTERIES; VEINS; LYMPHATICS; MUSCLES; TENDONS; BURSÆ

AFFECTIONS OF THE ARTERIES

Injuries

Inflammatory conditions { arteritis and periarteritis
thrombo-angiitis obliterans

Aneurysm { true or simple aneurysm
false, or pulsating hematoma

Arteriovenous aneurysm { aneurysmal varix
varicose aneurysm
pulsating exophthalmos
cirsoid aneurysm

Arteriosclerosis

Embolism

Thrombosis

Injuries

Arterial injuries result from penetrating wounds, especially gunshot and stab wounds; from crushing injuries; and occasionally from penetration by one of the fragments in a fracture, especially of the compound variety. They occur most frequently in the extremities and neck, although they appear in the arteries of the head and trunk as well. The wounds vary from minute lacerations or punctures of the vessel wall to a complete division.

The signs and symptoms vary with the location. Wounds of the aorta or its major branches, excepting minor tangential wounds, are rapidly fatal. Those of smaller vessels of the abdomen or thorax produce symptoms of internal hemorrhage; while in the head, if not fatal, the symptoms may be construed either as due to hemorrhage or to shock associated with cerebral injury. It is well to recall that intracranial arteries may be seriously damaged, not only in penetrating injuries, but also in closed wounds, with or without skull fracture. Also, that hemorrhage from the meningeal artery is usually delayed in cases of head injury, and follows a lucid or relatively clear mental interval.

In the extremities, if the vessel injury is easily continuous with the wound through the skin, there is profuse external bleeding with increased flow during the systolic phase. If the wound entrance is small, the vessel deep seated, or the path of the missile or penetrating object is indirect or tortuous, there is hematoma formation—a soft swelling in the early stages, perhaps with an audible

murmur over it; in the later stages, it becomes hard and occasionally organizes; usually it becomes gradually absorbed. The general symptoms of hemorrhage and shock vary according to the amount of blood lost. The local symptoms also vary according to the extent of the injury and the vessel injured. Complete division of one of the main trunks in an extremity causes immediate absence of pulsation below the level of injury, blanching of the distal parts and gradual reduction of surface temperature.

Complications include infection; secondary hemorrhage; aneurysmal formation, and gangrene. Gangrene depends upon the vessel injured and the efficiency or absence of collateral circulation, and appears distally. It is of the *dry type*, unless venous injury occurred in conjunction with the arterial trauma.

Inflammatory Conditions

Arteritis and Periarteritis.—Arteritis or inflammatory affection of the arteries is a secondary condition, associated with local infected wounds or other inflammatory processes. In most instances, the changes are limited to the adventitia or outermost arterial covering, the condition really being a periarteritis. No distinctive symptoms are associated. In more severe forms, the entire wall may be diseased, as in an abscess cavity—pyogenic or tuberculous—producing necrosis and hemorrhage. In other cases, thrombosis results, and, secondarily, emboli in other parts of the body, with or without true pyemia.

Inflammatory processes also occur in the intima, notably from the toxins of disease, such as syphilis; also from continued use of exogenous substances in excess, as alcohol and tobacco; and further, in conditions associated with faulty elimination and disturbed metabolism. These processes are not, as a rule, truly inflammatory, but partake of the characteristics of a thickening process or sclerosis. Infective emboli from other parts of the body will also excite an arteritis from within.

Thrombo-Angiitis Obliterans.—A notable exception to the above generality is thrombo-angiitis obliterans, a progressive arterial inflammatory process, characterized pathologically by increasing endarteritis with gradual obliteration of the lumen, and in unfavorable instances by terminal gangrene.

Aneurysm

True Aneurysm.—This is a localized dilatation of the arterial wall, occurring chiefly in middle age and in males. The dilatation assumes various forms, according to the site of weakness in the vessel wall; and thus may be fusiform when the entire vessel is distended; sacculated when one wall is weak; cylindrical, etc.

Syphilitic infection is the prime factor in the development of an aneurysm, although hard work, alcoholism and the toxins of chronic diseases and metabolic disorders may play a part. Injury is an important etiologic factor.

The thoracic aorta is most commonly affected. The abdominal aorta ranks about fourth in order of frequency; the popliteal, femoral, carotid, subclavian, innominate, axillary, and iliac vessels are affected in approximately this order.

In the organs of the body, an aneurysm is most commonly found in the brain, involving the circle of Willis. A rare form of aneurysm is that of the renal artery.

The condition is gradual in onset and progression. In the earliest stage it appears without symptoms or with those of the attendant factors, such as hypertension. Among those which later appear are pain and paresthesia, these depending upon pressure of the sac upon adjacent nerves and commonly referred to distal portions. In the late stages, the circulation may be materially interfered with, causing coldness of the distal parts, and sometimes gangrene.

Aneurysm is a progressive condition, rupture of the sac being the ultimate phase, although spontaneous healing very infrequently occurs, following fibrin deposition and organization within the sac. Emboli may become broken off, causing plugging of the vessel distally, or of vessels in other regions of the body.

Objectively, in the extremities and neck, a visible mass is noted in the anatomic line of an artery. This mass has an expansile or spreading pulsation, synchronous with the heartbeat. This may best be appreciated by palpation which also usually detects a systolic thrill over the mass. Upon auscultation there is a rushing systolic sound or bruit. Pressure over the artery between the mass and the heart will diminish the size of the mass, while pressure on the distal side increases the mass and renders it more tense. The blood-pressure beyond the aneurysm is usually lower than that of the corresponding level on the unaffected side, although hypertension is, as a rule, noted as a feature of the general condition. The Wassermann reaction is usually positive in cases of spontaneous aneurysm. When nerve pressure is marked or prolonged, anesthesia and actual motor paralysis may be found. Where the aneurysm approaches the surface, the skin may become reddened, indurated and sometimes edematous; these signs in combination with local tenderness suggest an underlying inflammatory condition.

Traumatic or false aneurysm is practically identical in its symptomatology, but it may be recognized by the history of penetrating injury and its rapid onset.

Arteriovenous aneurysm is another sequel of penetrating wounds, and is a condition in which both the artery and its companion vein are involved. It is seen in the extremities, particularly the lower, but may also occur in the cervical region and in relation to the temporal vessels. During the recent war, the most frequent site was the posterior tibial artery.

There are two special varieties:

1. *Aneurysmal varix*, in which the wound or missile has involved the artery and the vein lying in contact with each other, there being a direct communication from the artery to the vein with subsequent dilatation and varicosity of the weaker vein.

2. *Varicose aneurysm*, in which an aneurysmal sac lies between the artery and vein and communicates with both vessels. In the beginning, the artery and vein are not contiguous, but an hematoma is formed at the time of arterial injury, and subsequently a false aneurysm, lined by connective tissue, is produced, this ultimately eroding and perforating the vein, and forming an arteriovenous communication.

An arteriovenous aneurysm is indicated by the presence of a continuous palpable thrill over the vessels, with an audible and usually vibratory rough murmur which is also continuous but more marked during systole, and which is usually transmitted to both higher and lower levels. In the extremities, the calf, for instance, is larger than its fellow. Paresthesia and muscular cramps are frequently complained of, and pain is fairly common. Interference with the venous supply causes swelling and edema, superficial varicosities which may pulsate, and perhaps pigmentary changes and cutaneous eruptions or ulceration. In varicose aneurysm, if the sac is well developed and not deeply seated, a mass with an expansile pulsation and the usual signs of aneurysm can be observed.

A special variety of arteriovenous aneurysm is *pulsating exophthalmos*, in which there is marked exophthalmos with visible pulsation of the globe; edema of the conjunctiva and lids; usually severe pain; a palpable thrill and loud murmur over the globe and sometimes over the forehead; and diminution in size, or disappearance of the murmur and thrill upon compression of the carotid artery. It follows injury to the head or to the eye itself, and is in most instances attributable to an arteriovenous communication of the ophthalmic vessels or between the internal carotid and the cavernous sinus. In non-operative cases, optic atrophy ensues.

Cirroid aneurysm occurs particularly about the temporal region, where the vessels appear dilated, tortuous and pulsating, spreading upward toward the vault and forward toward the frontal region. The distended vessels beneath the thin skin are of deep blue color or bluish red, and intertwined, giving a general varicose appearance, sometimes so marked that the affection has been styled "racemous aneurysm." Pressure over the external carotid or the temporal artery proximal to the mass diminishes its size.

Arteriosclerosis

This condition is considered surgically because the affection gives rise to such diseased states as thrombosis, embolism, and the like.

Embolism

Embolism consists of a plugging or blocking of the arterial lumen by material conveyed within the blood stream. Embolism may be: (1) Infective, as from purulent foci, or active endocardial vegetations; (2) non-infective, as from fragments of blood-clot washed from a thrombosis or the sac of an aneurysm, or from globules of fat from the marrow of injured bones; or (3) malignant, from a tumor in any location. Embolism takes place particularly in terminal vessels such as those of the brain, and is also frequent in the larger capillary and blood-filtering areas, such as the lungs, kidney and spleen. It is not uncommon, however, in the extremities. Important sources of embolism include vessels, particularly those of the female pelvis, ligated during operation; excessive amounts of fat subjected to incision or excision as in the abdominal wall; fractures of the long bones, simple or compound; air entering a vein during intravenous injections; and materials mistakenly introduced directly into the blood stream, such as bismuth and mercury preparations.

In the brain, the symptoms are those of acute cerebral anemia, with the presence of localizing signs which are dependent upon the vessel blocked and the cerebral area which it ordinarily supplies. In the lungs, an infarct results, anemic in type. In the extremities, the pathology depends upon the site of embolism and the presence or absence of collateral circulation. If a main vessel is plugged, or a lesser vessel without collateral provision in its area of supply is plugged, gangrene of the dry type ensues.

Sudden onset is one of the essential characteristics. Another constant feature is *pain*, although this may be masked, in the case of cerebral and pulmonary embolism, by immediate unconsciousness. In the lungs, however, a rise in pulse rate and respirations, and later elevated temperature are noted. The signs are those of lung consolidation, frequently atypical, and there may be blood-streaked sputum. Probably, the majority of postoperative "pneumonias" are embolic or thrombotic processes. Not infrequently, pulmonary embolism is fatal, the patient being seized with acute thoracic pain, accompanied by cyanosis, dyspnea and a rapid, feeble pulse, and passing almost immediately into coma.

Thrombosis

Thrombosis is more characteristically venous than arterial. It does occur in the arteries, however, especially in vessels that have been gradually thickened and partially obliterated by endarteritis; advanced age, various toxins, such as those of syphilis, tuberculosis, nephritis, diabetes and gout, are all predisposing causes. Impaired circulation and lowered blood-pressure conditions, for example, in such affections as myocarditis, anemia, and chlorosis, predispose toward thrombus formation. Thrombosis frequently occurs *proximal to an embolus*. Infective processes, by extension, are sources of thrombosis, while extra-arterial pressure, brought about by a tumor or abscess, is a fairly frequent cause.

Arterial thrombosis is commonly of subacute onset, the actual complete plugging of the vessel being preceded by symptoms of the underlying cause, which in most instances is impaired circulation. With demonstrable arterial thickening, anemias, lowered blood-pressure, a tumor mass in relation to an artery, aneurysm, injury, cicatrices about a vessel, enlarged glands, etc., the occurrence of numbness and tingling, lowered surface temperature, diminution in pulse and premonitory pain are very suggestive of beginning thrombosis. These symptoms are intensified when the thrombosis is complete. Absence of pulsation below the site of obstruction occurs. The ultimate outcome is gangrene, of the dry type; occasionally there is a restoration of circulation, partial or complete, with a corresponding return of function and sensation.

While thrombosis in the extremities is of chief interest to the surgeon, he will occasionally be called upon to consider cerebral thrombosis, particularly in the differentiation of unconsciousness, due to conditions such as cerebral tumor and abscess, and cerebral complications following operations about the scalp and skull, as well as those in other regions of the body. Here again, the gradual onset in most instances, with premonitory symptoms in the majority, and the recognition of an etiologic factor, will be of great aid.

AFFECTIONS OF VEINS

Injury

The veins may be injured by blows, falls and other traumatic conditions which do not involve cutaneous wounds, as well as by penetrating wounds. Thus, contusions, lacerations and rupture may occur from injury. When a penetrating wound exists, hemorrhage may appear externally. Frequently, the bleeding is subcutaneous, its presence being indicated by subcutaneous ecchymosis, the familiar "black-and-blue" spots; by hematoma formation; or by engorgement of the superficial veins.

A remote result of injury, particularly that of a gunshot wound, is varicose aneurysm.

Inflammatory Conditions

Inflammation of the veins, or *phlebitis*, arises secondarily to wounds, varicose ulcers, adjacent infective processes, septic conditions, and remote infections by means of embolic transmission. The patient experiences pain in the affected area, and observes localized or generalized swelling of the extremity. When the affected vein is superficial, the overlying skin appears reddened and indurated, while the vein itself forms a palpable hardened, cordlike structure, which is quite tender. When the larger veins are involved, these signs may not be present, but the swelling and edema of the limb; dilatation of the superficial veins; the deep-seated pain; and the constitutional reaction usually make the diagnosis clear. Such a condition is often spoken of as *thrombophlebitis*, thrombosis of the vessel being a coexistent feature. Single or multiple abscess formation and cellulitis are frequent complications of phlebitis; the infective thrombus may give rise to emboli elsewhere.

A frequent origin of phlebitis is infection of the uterus with extension to the veins of the broad ligament, and frequently to the iliac vessels, as well. This occurs chiefly after abortion and miscarriage, but may follow normal delivery and operations.

Embolism

Embolism is less common in the veins than in the arteries. The symptoms vary with the site affected. In the extremity they are analogous to those of thrombosis, but may be more rapid in onset. The diagnosis depends very largely upon the recognition of a source, such as endocardial vegetations, thrombophlebitis, septic processes, operative procedures, etc.

Thrombosis

Thrombosis of veins occurs in the presence of phlebitis of an infective nature, and is also frequently due to chronic intoxications, such as syphilis, gout, Bright's disease and alcoholism. Injuries and prolonged pressure or other factors which impede the venous flow, predispose to, or cause thrombosis. An important source is ligation of vessels, particularly in the pelvis. In the acute cases, there is sudden pain at the site of thrombosis radiating along the course of the vessel. If a large

vessel is involved, peripheral edema, which gradually progresses upward, soon appears and superficial veins become dilated and engorged. There is usually tenderness over the vein, and if it is palpable, it will frequently be found to be more resistant to pressure.

Gradual occlusion, as by the intoxications, produces gradual swelling, venous stasis and, later, edema. Acute complete thrombosis often occurs when partial occlusion has long preëxisted.

A fairly common type of thrombosis is that of the femoral or iliac vein during pregnancy, which is known as "phlegmasia alba dolens" or "*milk-leg*." Any thrombosis including this variety may lead to obliteration of the vessel and persistent edema of the extremity.

See "Sinus Thrombosis" under "Affections of Head."

Varicose Veins

Varicose veins develop from many causes, the essential factors being structural weakness and sluggish circulation, the latter as the result of cardiac disease, pressure upon the veins, injury, partial thrombosis, their anatomic position and other considerations. The lower extremities are chiefly affected, the superficial veins appearing dilated, congested and tortuous. These signs are more marked in the upright posture or when pressure is made over the saphenous opening. Readjustment and elevation of the limb cause the veins to become smaller or disappear, and also diminish the swelling, if such is present. Moderate swelling is common and such complications as true edema, ulceration, cutaneous pigmentation and eczema, phlebitis and thrombosis may result. Subjectively, the patient complains of pains in the limbs, aggravated by standing and walking, and of gradual increase in the size of the foot or leg, most marked at night. Varicosities are also frequent in the spermatic plexus, especially of the left side; and in the abdominal wall as the result of cirrhosis of the liver or pressure upon the inferior vena cava. Less commonly, they are observed over the thorax and neck in the presence of mediastinal tumor, aneurysm and chronic mediastinitis.

AFFECTIONS OF THE LYMPHATICS

Injuries

Inflammatory conditions { acute lymphangitis
acute lymphadenitis and abscess
chronic lymphangitis

Granulomata { syphilis
tuberculosis

Lymphatic obstruction (lymphedema) { traumatic
inflammatory
cicatricial
parasitic (filariasis)
pressor
idiopathic or sporadic

Tumors

Injuries

Injuries of the lymphatic channels are not usually of sufficient extent to induce symptoms; they occur to some degree in traumatic conditions of the soft parts, especially contusions, and account, in part, for the stasis and edema so frequently observed. The *thoracic duct*, the solitary lymph-channel of noteworthy size, usually escapes injury because of its protected location; very rarely it may be injured by a gunshot wound or other penetrating missiles. If this occurs in the thorax, the condition known as chylothorax results (see "Injuries of Thorax"). The duct may also be injured at the base of the neck near its termination, by external violence or surgical procedure; a fistula draining milky white fluid then appears. Accompanying this is a rapid loss of weight and strength. The fistula may close spontaneously or persist.

Severe and diffuse traumata, as in the extremities, sometimes occasion lymphatic obstruction which may become chronic in type; while surgical removal of important nodes, as in the axilla during radical breast amputations, may give rise to a similar condition in the area drained by these nodes.

Inflammatory Conditions

Acute lymphangitis is seen in infective processes about the extremities, where its occurrence represents extension of the infection or inflammatory condition along the lines of lymphatic drainage. It is indicated by fine, pinkish or reddish streaks which extend from the site of infection toward or up to the regional nodes, and is usually associated with some enlargement of the nodes as well. In some instances, wide ascending bands, rather than streaks, may be noted, to which condition the term "tubular lymphangitis" is applied. The spread of infection along the lymphatics is frequently observed in the breast, chest wall, buttocks and perineum, but is most easily detected in the extremities. From the surgical standpoint, lymphangitis is always a danger signal marking the advancement of an invading organism. *Secondary abscesses* may be formed along the route of lymphatic absorption.

When lymphangitis appears, general symptoms in the form of malaise, elevation of pulse rate and temperature accompany an increase in the local signs.

Acute Lymphadenitis.—Acute inflammation of a lymph gland is the result of extension of infection either from contiguous tissues or through the lymph-vessels. The glands draining an infected area always show the usual evidences of inflammation, *i.e.*, heat, swelling and pain. The degree of lymph-gland involvement depends upon the severity of the infection. In mild cases there may be no fever and only moderate enlargement of the regional glands; the result is complete resolution or a chronic fibrous induration. In a severe case there is fever, marked swelling and pain, while the glands may break down and suppurate or become gangrenous. A periaidenitis follows with formation of an *abscess* which tends to extend to the surface where it breaks through the skin unless incised and drained. If the infection is not controlled, more serious extension to the entire system may follow an acute lymphadenitis.

Chronic lymphangitis is really a condition of lymphedema, with recurrent attacks of inflammation, and results from repeated attacks of acute lymphangitis or other conditions causing lymphatic obstruction.

Granulomata

Granulomatous affections of the lymphatic vessels are not common. A cordlike swelling of the lymphatics, extending from a primary chancre to the regional nodes, for example, along the dorsum of the penis, may be infrequently observed in *syphilis*. *Tuberculous* disease in an extremity, for example, in the phalanges, as in *spina ventosa*, sometimes extends along the lymphatics, presenting firm nodules, at intervals. These in the course of time break down and form abscesses. The tuberculous infection in this type usually affects the adjacent nodes and frequently becomes generalized. See Differential Chart, "General Enlargement of the Lymph Glands:"

Lymphatic Obstruction

Lymphatic obstruction, or *lymphedema*, arises from various causes. It may be due to trauma, usually of a severe type and widespread, as after a crushing injury of the leg. Some cases are attributable to surgical traumata, as in axillary node dissections. Lymphedema also complicates infective and inflammatory affections of the soft tissues, and is a fairly common sequel of a chronic ulcer of the leg, particularly of the varicose type. Cicatrices of injuries or operations at certain points, as axilla and groin, will sometimes produce lymphatic obstruction, especially when the channels have also been interrupted by removal of the nodes. The *Filaria sanguinis hominis*, lodging in the inguinal lymphatics, gives rise to a somewhat soft swelling of the external genitalia, which may reach enormous size; and which is painless. It is rare in this country. Numerous papillomata or cutaneous warts occur in conjunction, and the affected tissues are subject to recurrent attacks of lymphangitis. More striking is the similar affection of one or both legs, which increase gradually in size, oftentimes with inflammatory reactions, and ultimately with cutaneous changes and diffuse edema. This is known as *elephantiasis*, and is found particularly in the tropics. The limb may attain unwieldy proportions, the original size being increased three or four times, or even more. The filaria may frequently be obtained from the blood at night.

Lymphatic obstruction may also occur from compression, the so-called *pressor* group, as by tumors and aneurysm. Venous compression is usually a factor in these cases.

There remains a group of instances of lymphedema which cannot be explained by any of the known etiologic factors. These are cases of lymphatic obstruction of the lower extremities and genitalia, which resemble filariasis in progression, the presence of papillomata and other cutaneous changes (thickening, fissures and fibrous changes, often with pigmentation) and recurrent lymphangitis.

The symptomatology in all groups is similar, varying from a soft swelling of the tissues to a tense, somewhat brawny enlargement, which ordinarily is painless, until the size becomes a physical handicap or inflammatory reactions take place. In the exaggerated forms, the extremity or other part affected may assume a grotesque shape. Secondary changes in the skin, as mentioned, are common.

Tumors

(See chapters on "Tumors" and following chart.)

GENERAL ENLARGEMENT OF THE LYMPH GLANDS

Generalized lymph-node enlargements	primary secondary	leukemia (lymphatic) Hodgkin's disease glandular fever (Pfeiffer's disease) hypertrophy and hyperplasia
		syphilis tuberculosis metastatic sarcomatosis metastatic carcinomatosis

History

Age; Sex; Occupation; Nativity

Family History.—Tuberculosis, cancer and other tumors, syphilis, blood diseases, "enlarged glands," sudden deaths.

Personal History.—Acute infectious diseases, alcoholic and venereal history, tuberculosis, recurring attacks of tonsillitis, adenoid disease, tendency toward hemorrhages, and history of indigestion.

Present Illness.—Onset, character and time, site of region first affected, time between appearance of first enlargement and other mass formation. Sore-throat or digestive disturbance immediately preceding present illness. Cough, dyspnea, weakness, palpitation, recent bleeding from nose, gums or stomach. Chills and fever. Injury. An inflammatory condition prior to the appearance of present condition.

Physical Examination.—Nutrition, color of skin, edema; examination of throat; complete description of area involved, including location, size, consistency, contour, fixed or movable, single or multiple, confluent or discrete, condition of skin over diseased area. Signs of surrounding inflammation. Pain on pressure; intra-abdominal fluid and tumor mass. Examination of spleen and liver. Blood examination, tuberculin test. Histology. Blood-pressure. Wassermann test and reaction to potassium iodid.

Pathogenesis.—Leukemia (lymphatic), syphilis, Hodgkin's disease, malignant lymphoma and blastomycosis, glandular fever (Pfeiffer's disease), tuberculosis, hypertrophy and hyperplasia, metastatic sarcomatosis, metastatic carcinomatosis. Never confuse diffuse lipomata with the above conditions.

INTERPRETATION OF HISTORY

Age

<i>To Puberty</i>	glandular fever syphilis tuberculosis hypertrophy and hyperplasia
<i>Young Adult</i>	Hodgkin's disease malignant lymphoma and blastomycosis metastatic sarcoma tuberculosis

Adult { syphilis
Hodgkin's disease
malignant lymphoma and blastomycosis
metastatic sarcoma
tuberculosis
leukemia (lymphatic)
metastatic carcinomatosis

Advanced Age { metastatic carcinomatosis

Sex.—Leukemia, syphilis, Hodgkin's disease, malignant lymphoma, blastomycosis and sarcomatosis are most commonly found in the male.

Family History.—*Blood Diseases.*—We think of leukemia and Hodgkin's disease as possibly hereditary. The laity often considers "enlarged glands" as being a blood disease.

Sudden Deaths.—Hypertrophy and hyperplasia (relatives often die of a status lymphaticus) which is related to the above.

Personal History.—*Acute Infectious Diseases.*—Leukemia, Hodgkin's disease and glandular fever are often allied with the above history.

Alcoholic and Venereal History.—Syphilis.

Tuberculous History.—Tuberculosis, possibly Hodgkin's disease and leukemia; the laity often believes that any glandular enlargement is a "scrofulous disease" which they ally with tuberculosis.

Adenoid Disease History.—Leukemia, Hodgkin's disease, hypertrophy and hyperplasia.

Tendencies toward Hemorrhage.—Leukemia, syphilis, Hodgkin's disease.

Present Illness.

<i>Onset</i>	{	acute	{ tuberculosis (rare) lymphatic leukemia Hodgkin's disease (rare) malignant lymphoma and blastomycosis glandular fever
		subacute	{ syphilis metastatic sarcomatosis
	{	chronic	{ lymphatic leukemia (rare) Hodgkin's disease (common) metastatic sarcomatosis metastatic carcinomatosis hypertrophy and hyperplasia tuberculosis (more common than acute)

Time between Appearance of First Enlargement and Other Mass Formations

Progressive { syphilis
Hodgkin's disease
malignant lymphoma and blastomycosis
metastatic sarcomatosis
metastatic carcinoma
tuberculosis
leukemia

Hypertrophy and hyperplasia generally are stationary after a certain amount of growth.

Syphilis generally starts in the posterior cervical or inguinal group.

Hodgkin's disease, malignant lymphoma and blastomycosis generally begin in the cervical glands, then to axilla, groin and mediastinum.

Sore-Throat or Digestive Disturbance Immediately Preceding Illness.—Leukemia, syphilis, Hodgkin's disease, glandular fever.

Cough and dyspnea may be present in any, depending upon the advancement of the disease, and its relation to important structures.

Weakness may be present in all but hypertrophy, and depends upon the acuteness of the condition and the lateness of the disease.

Recent Bleeding from Gums, etc.—Lymphatic leukemia, syphilis, Hodgkin's disease.

Chills and Fever.—Leukemia (very often); Hodgkin's disease (recurring acute exacerbations); glandular fever. May be in any of the others, depending upon amount of intoxication.

Physical Examination.—*Nutrition.*—All of these affections impair the nutrition with the exception of hypertrophy, the amount depending upon the advancement of the disease.

Size.—All diseases may present any size of enlargement, though lymphatic leukemia and hyperplasia usually show small-sized masses.

Condition of Skin over Diseased Area

Normal	{	leukemia
		syphilis
		Hodgkin's disease
		malignant lymphoma and blastomycosis
		metastatic sarcoma (at first in all conditions)
		metastatic carcinoma
		hypertrophy and hyperplasia
		glandular fever
		tuberculosis (at first)

As the varied conditions advance the skin may show signs of change in all but the following, in which the skin usually remains *intact*: Leukemia, Hodgkin's disease, hypertrophy and hyperplasia, usually syphilis. The others may go on to ulceration.

Pain on Pressure

Negative	{	leukemia
		syphilis
		Hodgkin's disease
		malignant lymphoma and blastomycosis
		hypertrophy and hyperplasia

Usually positive as disease advances { sarcoma (may be none)
carcinoma (may be none)
tuberculosis (may be none)

Always present { glandular fever

Intra-abdominal Fluid.—Leukemia, as disease progresses; Hodgkin's disease, as disease progresses; malignant lymphoma and blastomycosis; sarcoma, as disease progresses; carcinoma, as disease progresses.

Examination of Spleen and Liver (Enlarged).—Leukemia; Hodgkin's disease; sarcoma, as disease advances; carcinoma, as disease advances; perhaps syphilis, as disease advances.

Blood Examination.—Any but hypertrophy and hyperplasia may, at some stage, show anemia; leukemia shows great leukocytosis, and characteristic mononuclear increase; Hodgkin's disease may show slight leukocytosis and eosinophilia (not constant).

Tuberculin Test.—Positive in tuberculosis. May be positive in the very advanced stage of Hodgkin's disease.

Histology.—Definite in all.

Wassermann and Reaction to Potassium Iodid.—Syphilis.

DESCRIPTION OF GLANDS

Disease	Contour	Fixed or Movable	Discrete or Confluent	Consistence
Leukemia (lymphatic)	Regular	Movable	Discrete	Soft and somewhat boggy
Syphilis	Regular	Movable	Discrete	Fairly hard
Hodgkin's disease	Rather irregular	At first movable	Discrete	At first soft and elastic, then firm and hard
Malignant lymphoma and blastomycosis	Regular	Movable	Discrete	Usually fairly soft
Metastatic sarcoma	Rather irregular	At first movable	At first discrete	Usually hard
Metastatic carcinoma	Rather irregular	At first movable	At first discrete	Usually hard
Hypertrophy and hyperplasia	Regular	Movable	Discrete	Soft
Glandular fever	Regular	Movable	Discrete	Soft
Tuberculosis	Somewhat irregular	Early, movable Soon fixed	At first discrete then confluent	Generally soft, often fluctuant

Symptom	Hodgkin's Disease	Hypertrophy and Hyperplasia	Glandular Fever	Lymphatic Leukemia
Age	Young adults. Adults.	To puberty.	To puberty.	Young adults. Adults.
Family history	Possibly of "blood diseases" or of "enlarged glands."	Possibly of "sudden deaths" (status lymphaticus).	Negative.	Possibly of "blood diseases" or of "enlarged glands."
Personal history	Acute infectious diseases, sore-throat or adenoid disease. Tendency to hemorrhage from nose, gums or other mucous membranes. Digestive disturbances.	Enlarged tonsils and adenoids.	Possibly acute infectious diseases, sore-throat and digestive disturbances.	Possibly, acute infectious diseases, enlarged tonsils and adenoids, tendency toward hemorrhage from mucous membranes.
Onset	Chronic. Acute (rare).	Very chronic.	Acute.	Acute. Chronic (rare).
Involvement ..	Most commonly involves the neck, then axilla, groin and mediastinum.	Vast majority of lymphatic chains, no predilection.	Vast majority of lymphatic chains, no predilection.	Vast majority of lymphatic chains, no selection.
Consistency and contour	At first is soft, somewhat boggy, then firm, hard. Regular or slightly irregular.	Soft and regular.	Soft and regular.	Soft and somewhat boggy. Regular.
Fixed or movable	At first movable; then fixed.	Movable.	Movable.	Movable.
Discrete or confluent	Usually discrete.	Discrete.	Discrete.	Discrete.
Condition of skin over diseased area	Negative.	Negative.	Negative.	Negative.
Pain on pressure	No.	No.	Yes.	No.
Enlargement of spleen and liver	Usually not at first. Later become enlarged.	No.	No.	As a rule enlargement is present.
Laboratory data	Blood negative, but at times slight leukocytosis and moderate eosinophilia (rare). Positive histology.	Histology. Usually some lymphocytic increase.	Leukocytosis	Histology. Marked lymphocytosis. Typical blood-picture.
Remarks	As disease progresses, acute exacerbations, chills and fever often present. Radiographic examination of mediastinum, important.	Very common in children.	Chills and fever. Often sore-throat ushers in attack. Mononucleosis.	As disease progresses intra-abdominal fluid may be detected. Very often chills and fever. Recent bleeding from mucous membranes. Gastric, intestinal disturbances.

GENERALIZED ENLARGEMENTS OF THE LYMPH GLANDS

Syphilis	Tuberculosis	Malignant Disease	Symptom
Congenital. Adults.	To puberty. Adults.	<i>Sarcoma</i> : Young adults; adults. <i>Carcinoma</i> : Adults; advanced age.	 Age
Possibly history of syphilis.	Possibly history of tuberculosis.	May be malignant disease history.	Family history
Primary lesion. Eruptions. History.	May be history of tuberculosis elsewhere.	Usually history of primary growth elsewhere.	Personal history
Subacute.	Chronic. Acute (rare).	<i>Sarcoma</i> : Subacute or chronic. <i>Carcinoma</i> : Chronic.	 Onset
Usually starts in posterior cervical or inguinal glands.	Usually in the neck.	Primary chain depends on region primarily affected.	.. Involvement
Fairly hard and regular.	Fairly hard, soft or fluctuant. Somewhat irregular.	Usually hard, somewhat irregular.	Consistency and contour
Movable.	At first movable, then fixed.	At first movable, then fixed.	Fixed or movable
Discrete.	At first discrete, then confluent.	Discrete, then confluent.	Discrete or confluent
Negative.	At first negative, then blue-red discoloration. Sinus.	At first negative. As disease progresses, involvement of skin with possible ulceration.	Condition of skin over diseased area
No.	At first negative, later pain is present.	At first negative, later pain is present.	Pain on pressure
Liver and spleen may become enlarged as the disease progresses.	Not enlarged as a rule.	As the disease progresses, liver may become enlarged.	Enlargement of spleen and liver
Positive Wassermann.	Possible, positive tuberculin. At times tubercle bacilli may be isolated from gland.	Histology. Signs of anemia.	Laboratory data
Reaction to KI. Other clinical data such as that of primary and secondary eruptions.	Possibly, tuberculosis elsewhere in the body.	Eventually cachexia. Usually find primary focus.	 Remarks

AFFECTIONS OF THE MUSCLES

Injuries	{	contusions wounds rupture hernia
Inflammatory conditions	{	simple myositis infective myositis abscess
Granulomata	{	syphilis tuberculosis actinomycosis
Parasitic affections	{	trichinosis hydatid cyst
Myositis ossificans		
Spasm		
Atrophy		
Hypertrophy		
Tumors	{	benign { fibroma angioma desmoid malignant { sarcoma

Injuries

The muscles may be injured by direct violence or by indirect means, in the latter case the result being due to the contraction of the muscle itself. Among the direct injuries are contusions and lacerations.

Contusions.—Minor contusions are indicated by soreness and stiffness of the affected muscle or group of muscles, often with the presence of ecchymosis. In more severe contusions, hemorrhage sometimes occurs, with the formation of an hematoma, indicated by a circumscribed fluctuant or elastic swelling in the course of the muscle. This may undergo complete absorption or produce a cystic condition which persists; or it may become calcified, leaving within the muscle a hardened nodule of variable size. Infection is a somewhat rare complication of an hematoma.

Lacerations may be very slight, or may cause partial or complete division of a muscle or muscles, and are always potential avenues of spreading infection.

Rupture of a muscle occurs as the result of violent contraction, and is more common in debilitated persons or atrophied muscles. The condition may be obscured at first by the presence of an hematoma. It is manifested by a palpable, and frequently visible break or groove in the muscle contour, with adjacent swelling due to the belly of the muscle. Upon voluntary effort, the function of that particular muscle is absent, although the proximal portion of it is observed to contract; or at least an effort at contraction is made. The muscle as a whole, how-

ever, fails to become rigid. In the later stages there is marked atrophy of the divided portions. A few fibers of a muscle may also be divided or "pulled" as a result of severe and unusual contraction; this occurs especially in athletes and construction workers, examples being a division of the fibers in the *gastrocnemius* in tennis players, and a similar affection of the *adductor longus* in workmen who suddenly attempt to regain a standing posture while employed in an exaggerated straddling position. Myositis ossificans is occasionally a sequel of muscular injury. Volkmann's ischemic paralysis is another muscular affection, leading to contractures, which will be further considered.

Hernia.—A muscle hernia follows gunshot wounds, extensive muscle tearing and muscular exertion. Its presence is characterized by a soft, almost elastic bulging, clearly defined by palpation from the edges of the aponeurotic sheath through which it protrudes. Little or no muscular impairment may occur, or in severe cases, there may be a pronounced diminution in muscle function. The swelling disappears on pressure, but recurs immediately upon its release.

Inflammatory Conditions

Myositis, or inflammation of a muscle, is commonly divided into two varieties—simple myositis and infective myositis. In *simple myositis*, there is pain and stiffness and frequently a considerable impairment of function. This condition often arises quickly, particularly after exposure to the elements, and may be typified by the expressions "stiff neck" and "lumbago." According to the location of the myositis, certain movements are performed with difficulty or are impossible because of pain, while the protective spasm of the muscle or muscle group will often produce a marked distortion of the involved part.

Infective myositis follows penetrating wounds, or it may arise spontaneously. Spontaneous occurrence is seen very rarely, and then in individuals weakened by a protracted illness or chronic wasting diseases; in those exposed to severe weather conditions and poor food, as in Arctic explorers, the myositis may assume a rapidly gangrenous type. While a few cases are first manifested by general symptoms, the majority complain of pain and tenderness in the affected part, these being followed by swelling and involvement of the regional lymph-nodes. Accompanying the local symptoms there are fever, weakness and the usual reaction of a purulent process.

Abscess.—Infective myositis may spread rapidly, and may assume a fatal type. The most favorable termination of infective myositis of the severe type is abscess production, indicated by the usual signs.

Granulomata

Syphilis of the muscles occurs as a diffuse infiltration with hardening and atrophy, or as a gummatous process. The latter affects particularly the *sternomastoid* muscle and the *sphincter ani*, and is shown by a nodular mass within the muscle, and if not treated, it usually progresses to softening and degeneration and involvement of the overlying tissues. About the anus, a gumma may be quite painful. The history of the patient, facts revealed by general physical examination, the Wassermann test and the therapeutic reaction are important features in diagnosis.

Tuberculosis of the muscles is, as a rule, a secondary process, occurring in the presence of gland, joint or bone tuberculosis. Here, either a diffuse sclerotic infiltration or an abscess may be observed; its nature is suggested by the recognition of the original focus. A primary tuberculous infection does occur, however, without other regional disease. The affected muscle is the site of a firm nodule in the early stages; later, the usual course is softening and caseation, with decrease in consistency, and with secondary changes in the overlying skin and subsequent sinus production. It is likely to be located near the tendon of the muscle rather than within the belly of it. Obscure cases in which there is no apparent pulmonary or other lesion will be suggested by the chronic, painless course of the disease, but it must be differentiated from a gumma. Tuberculosis occurs more frequently in the muscles of the extremities, particularly those about the wrist.

Actinomycosis, when involving the muscles, is usually a secondary process. It may be identified by the infiltration of the overlying skin, with *multiple scarring* and *sinus* formations, and bluish-red discoloration of skin surfaces, together with the escape of sulphur granules. The *tongue* is a notable site of primary muscular actinomycosis, manifested in the early stages, simply by an intraglossal nodule of firm consistency, the characteristics of which, other than gradual increase in size, may be altered for some time. The surrounding tissues then become infiltrated, and sooner or later, perhaps following trauma, as from a tooth, ulceration of the mucous membrane appears. Instead of true ulceration, a sinus or more than one sinus may appear, this feature in itself being highly suggestive. In all suspected cases the discharge should be examined for the fungus, as clinically the resemblance to gumma may be striking, and the reaction to iodids is frequently similar in the two affections.

Parasitic Affections

Trichinosis.—The pork worm, *Trichina spiralis*, is a fairly common invader of the skeletal muscles. It should be suspected whenever diffuse muscular tenderness is observed without an apparent etiologic factor. Patients with this affection usually exhibit fever and malaise, and, which is significant, edema of the forehead and face. The combination of fever, muscular tenderness and eosinophilia is practically diagnostic, and the microscopic examination of bits of speared muscle tissue will often reveal the parasitic invader. In some instances, definite nodules may be felt in the muscles.

Hydatid cyst of the muscles is not common. Locally, a fluctuant or tense mass may be noted within the affected muscle. This is subject to secondary infection, producing pain, tenderness and increase in size. The nativity of the patient or the history of a sojourn in foreign countries may suggest the diagnosis. At times, the characteristic vibratory thrill may be felt. In doubtful cases examination for *hooklets* in the aspirated fluid should be made.

Myositis Ossificans

As previously noted, this affection may be a sequel of inflammatory affections of the muscles. It also occurs following injury, especially after fractures, and is noted particularly in the *brachialis anticus* muscle and the *quadriceps extensor*

tendon. The affection consists of a new formation of bone within the muscle substance, sometimes producing a hardened, palpable mass; at other times it is more diffuse and not easily outlined. Myositis ossificans may develop quickly following injury, and should be considered in cases where the function does not return as promptly as it should, or where disturbance of function, out of proportion to the original injury, results. Many cases can only be demonstrated by radiography.

A *congenital type*, or one occurring in early childhood, is also to be noted. Groups of muscles, especially about the trunk and shoulder-girdle and frequently those of the neck and extremities as well, may be involved. Casual palpation of the child gives the impression of rocklike consistence, the ordinarily "soft parts" being blended imperceptibly with the normal osseous framework. The condition is usually progressive and produces grotesque attitudes of the extremities, head and trunk which cannot be altered either voluntarily or passively.

Isolated myositis ossificans occurs from repeated trauma, as in the adductor longus in horsemen, where the condition is called "riders' bone."

Spasm

Spasm of muscles, as encountered in surgical conditions, is usually a protective feature—an effort on the part of the body to protect an area already invaded by some injurious agent. This defense mechanism is very rapidly instituted in intra-abdominal affections, particularly those of surgical import, and especially when the peritoneum, either visceral or parietal, is injured, infected, inflamed or irritated in some manner. The detection of rigidity and spasm of the muscles of the abdominal wall, the determination of the site and extent of such phenomena, and the appreciation of the viscera possibly responsible for these manifestations constitute a very significant factor in the framing of a surgical diagnosis. In all instances, it must be appreciated that this is a reflex condition; therefore, in supposed abdominal diseases, the careful surgeon considers the thorax, the peripheral nerves and the central nervous system as possible sites of the original disease masquerading in deceptive guise which may lure one to false diagnosis.

Rigidity and muscle spasm are also observed following injuries either to the soft tissues or to the osseous structures, overlying inflammatory processes, about joints which are or have been the seat of disease. They may be secondary to nerve injuries with paralysis or paresis of certain muscles and consequent overaction of their antagonists; and in many other conditions where muscular activity is called upon to guard an affected organ or to immobilize an injured or diseased part.

Atrophy

Atrophy is more frequently encountered than is hypertrophy of the muscles. Atrophy results from toxins of acute and chronic diseases; from inactivity, as when the patient is confined to bed during convalescence from an operation; from direct traumatism; from disuse, for example, following fractures and joint injuries; from nerve lesions and injuries; and from prolonged spasm, as about a tuberculous joint. Another important factor in muscular atrophy is ischemia, the result of vascular changes or from pressure of improperly adjusted splints or other retentive apparatus or surgical dressings. Cases of hemiatrophy have been reported.

Hypertrophy

Hypertrophy is usually a local condition dependent upon occupational or athletic development of certain groups. A physiologic degree of hypertrophy may be noted on the right side, particularly in the upper extremity, in right-handed individuals, and on the left in left-handed persons. Cases of hemihypertrophy have been reported and other types of muscular hypertrophy, or pseudohypertrophy, occur in the muscular dystrophies. From the surgical viewpoint, atrophy carries much greater significance than does hypertrophy.

Tumors

Benign.—Of the benign tumors, the *fibroma* appears as a firm, regular or slightly irregular nodule of variable size within a muscle. It is non-tender, grows slowly, and can be moved in the long axis of the muscle when the latter is passive; its mobility is decidedly restricted or inhibited when the muscle is contracted; the act of contraction may produce a slight change in location of the tumor. The *angioma* is usually softer than is the fibroma and its limits are not as accurately palpated. Following injury it may increase in size. The *desmoid* is a tumor of the abdominal wall. See chapter on “Affections of the Abdominal Wall.”

Malignant.—*Sarcoma* of the muscles is a rapidly progressive malignant tumor, which, in its early stages, appears as a swelling of the muscle, accompanied by a sense of lameness or pain of a minor degree; it may be present without symptoms. Rapid increase in size is, of course, very suggestive, while a diffuse swelling whose limits cannot be accurately made out should always be suspicious. Spreading along the intermuscular septa, and involving adjacent muscles, an oval or spindle-shaped swelling is produced; the advancement of the tumor may be limited by tense fascial planes; it then spreads laterally, appearing as a collar-like mass, surrounding or partially surrounding the shaft of the long bones, as in an extremity. Primary sarcoma of the muscles is more common in the extremities (particularly in the thigh) and occurs chiefly in young adults, although not uncommon in middle life. Its consistency varies with the location of the tumor and the type of predominating cell. Upon palpation, the mass is evidently incorporated within the muscle substance, and not movable independently, either transversely or in the longitudinal axis of the muscle. Adherence to the skin, and circulatory and pigmentary changes are late features, although very significant. The regional glands may or may not be enlarged. Radiographs will eliminate the bony structures as the site of origin. Pain is usually severe in advanced cases, and metastasis to internal organs along the blood stream may occur fairly early in the disease.

AFFECTIONS OF TENDONS

Injuries	{	wounds
	{	contusions
	{	rupture or separation
	{	dislocation

Inflammatory conditions {tenosynovitis

Granulomata	{	tuberculosis
		syphilis
Ossification		
Ganglion		
Tumors	{	benign {
		fibroma
		xanthoma
		lipoma
		malignant {
		sarcoma

Injuries

Injuries are of two varieties, penetrating and non-penetrating.

Wounds.—In open wounds, a tendon may be lacerated superficially or severely, or may be completely divided. The nature of the wound and the causative agent, the course of the wound or missile and the alteration of function establish the diagnosis. The extent of the injury can usually be easily ascertained by these observations, and by direct inspection of the wound after retraction of the skin flaps. In the larger tendons, division is evident by a gap in the usual contour and, at times, the retracted ends of the tendon may be palpated, frequently at some distance from the wound.

Contusions.—Non-penetrating injuries arise from direct injury or indirect violence. Contusions frequently incite an inflammatory reaction, with the symptoms of tenosynovitis. This may also be produced by violent or unusual exercise, as in the tendon Achilles in tennis players, frequently combined with an actual strain upon the tendon, as in the so-called “pulled tendon” of athletes.

Rupture.—An unusual effect of muscular action is the rupture of a tendon or separation of its attachment. The ligamentum patellæ, the tendon of the long head of the biceps, and the tendon Achilles are subject to such injuries. In the case of the latter, instead of separation or rupture, a portion of the os calcis at the site of insertion may be torn away, particularly if there has been direct trauma to the bone in the presence of extreme muscular effort.

Dislocation.—A dislocated tendon is an infrequent sequel of muscular effort. The peronei tendons as they curve below the malleolus are most frequently dislocated. The occurrence is indicated by severe pain and snapping sensation, and the tendon is found in an abnormal position over the malleolus, with a corresponding depression in the usual anatomic situation. Habitual tendon dislocation is observed in certain individuals, and may be produced voluntarily, as well as accidentally, in such patients.

Inflammatory Conditions

Tenosynovitis.—Acute tenosynovitis is an inflammatory affection of the tendon and its sheath, and arises from various causes. It may occur from direct trauma, but probably equally as often occurs from indirect injury, as in strenuous exercising. Clinically, tenosynovitis is indicated by a tender swelling of the affected tendon or tendons. This is quite painful, especially upon certain motions, and function is usually impaired according to the site of the affection. In some cases, there is a

small amount of fluid within the tendon sheath, which, in conjunction with the inflammatory thickening, gives a crepitant sensation upon palpation. The condition is met with in the extremities, particularly about the wrist and ankle joints. In those instances in which there is no history of direct injury or muscular strain, tenosynovitis may arise as a result of a gonorrheal, tuberculous or syphilitic infection. The gonorrheal type is quite sudden in onset, is found especially in the ankle-joint region, and is likely to involve more than a single tendon. The presence of a history of urethral discharge is of value in diagnosis.

Acute infective tenosynovitis is a serious condition following an open wound or infection. It occurs chiefly in the fingers and hand, and consists of a spreading infection of the synovial sheaths, which may assume alarming proportions, with associated lymphangitis and lymphadenitis, and a severe constitutional reaction. Infective tenosynovitis is extremely painful, and leads to prolonged infection and sloughing. The destruction may be so extensive that tendon function is ultimately lost, or contractures result from the inflammatory reaction. In open wounds the sloughing, disintegrated tendon may be seen at the base of the wound. In infections, the presence of tendon involvement may be indicated by the direction of the advancement of the infection, the sites of tenderness, the attitude of the hand, and the disturbed function.

Granulomata

Tuberculosis.—Tuberculous tenosynovitis occurs secondarily to regional tuberculosis, or it may develop as a primary affection without other demonstrable focus. Essentially, it is a low-grade process, running a chronic course, but it may be aggravated or incited by injury, in which case the process may be comparatively acute. It occurs in two forms, one of which is characterized by thickening of a chronic inflammatory nature, while the other is attended by caseation. In the first, the enlarged tendon, perhaps with some fluid in its sheath, can be palpated, and adherence to surrounding tissues is often demonstrable. In the palm of the hand, extension of this process along the synovial sheaths forms a diffuse, irregular infiltration, which is sometimes called a cystic hygroma of the hand. The caseous form is more frequently seen just above the wrist, presenting as a soft or firm mass beneath the skin. In later stages the mass becomes softened, with adherence to the skin and frequently with an accompanying change in color of the overlying skin, either reddish or bluish red. Unlike many tuberculous affections, tenosynovitis of this nature is very commonly painful. The chronic course, the tendency to extension, the appearance of adherence to the surrounding tissues, and, in the caseous type, the change in consistency will usually make the diagnosis clear. A sinus may be present.

Syphilis.—The syphilitic form is not usually as acute and diagnosis here largely depends upon the history, the presence of associated lesions of the disease and the Wassermann reaction.

Ossification

Ossification of tendons results from a single injury or repeated traumata. As mentioned, it occurs chiefly in the brachialis anticus and the quadriceps extensor tendon following injuries about the elbow and knee, respectively. In horse-men, ossification often occurs in the adductor longus, from repeated strain and trauma,

and may also be seen in the tendo achillis in athletes. Symptoms vary according to the site and extent of ossification. A hard, bony nodule is sometimes palpable, or the nature of the affection may only be demonstrated by x-ray. It suggests itself to the physician, when an unusual degree of restriction takes place, following injuries about the knee and elbow.

Ganglion

A ganglion consists of an accumulation of fluid within a tendon sheath. This frequently follows tenosynovitis. The fluid becomes encapsulated, or rather, limited, so that it presents as a cystic swelling which moves slightly upon tendon action and which becomes tense when the tendon is brought into play. A ganglion frequently arises quickly after muscular strain. It may disappear spontaneously or after direct trauma. It may be persistent and require operative removal. Pain is usually a minor or absent symptom. The condition is frequently multiple. It is seen mostly in the forearm near the wrist, particularly in relation to the extensor or flexor tendons.

Tumors

Benign.—Tumors of the tendons and their sheaths are uncommon. The *fibroma* appears as a circumscribed, firm nodule, usually of small size and of slow development, movable beneath the skin but attached to the underlying tendon. Its fixity is not absolute, but may allow slight mobility of the tumor in one or both axes of the tendon, and some associated movement may be demonstrated upon use of the tendon. The *xanthoma* has similar physical characteristics, although its consistency may be softer than that of a fibroma. Multiple xanthomata have been reported in the fingers and tendons about the wrist. The diagnosis can only be made when a high cholesterol content of the blood is known to exist. A *lipoma*, with its usual soft, lobulated feeling, occurs in the tendon sheaths. In the palm of the hand, it assumes, at times, a diffuse, infiltrating character, gaining for itself the appellation, *lipoma arborescens*.

Malignant.—*Sarcoma*, theoretically at least, may develop from the tendon or its sheath, according to Adami. No reported instances have been obtained.

AFFECTIONS OF BURSÆ

Injuries	{ traumatic bursitis wounds
Inflammatory conditions	{ acute bursitis chronic bursitis
Granulomata	{ tuberculosis

Injuries

Surgical affections of the bursæ occur frequently. Certain bursæ, because of their superficial location, are particularly subject to injury and thus to acute and chronic inflammatory processes. Among those are the bursa overlying the first

joint of the great toe; the prepatellar bursa, anterior to the ligamentum patellæ; the subpatellar bursa, posterior to the same structure; and the olecranon bursa, overlying the olecranon process of the ulna. There are, in addition, several bursæ which are less frequently considered in surgical diagnosis than they should be, largely because of lack of anatomic knowledge. Included among these is a small sac known as the thyroid bursa, which overlies the hyoid bone or the thyroid cartilage. Chronic bursitis in this situation simulates a cyst of the accessory thyroid gland. Another is the acromial bursa, situated over the outer extremity of the acromion process.

The subdeltoid bursa beneath the deltoid muscle is fairly frequently affected, causing difficulty in motions at the shoulder joint, especially abduction of the arm. Careful inspection will usually reveal a fullness in the deltoid region and palpation may give a sense of fluctuation. The x-ray is of great value in diagnosis, when calcareous changes have taken place.

Inflammatory Conditions

Between the tendon of insertion of the biceps and the head of the radius is a small bursa, which is rarely injured or inflamed. Posterior to the tuberosity of the ischium is a synovial sac which may become chronically inflamed in those pursuing an habitual sitting occupation. Beneath the tendon of the semimembranosus muscle is a bursa which infrequently is affected, the condition being unusually painful because of nerve pressure. Overlying the external malleolus is a bursa which may become irritated from constant pressure, as in tailors, who assume a cross-legged attitude with unusual pressure on the external malleoli. There are also several prolongations of the true joint bursa, notably about the shoulder and knee, which may become involved in bursitis of those joints, or may exhibit isolated swellings. Among these are the bursæ in relation to the long head of the biceps, and the supraspinatus and infraspinatus tendons. Some of the deeper-seated tendons and muscles also have bursæ related to them, but affections of these do not lend themselves readily to diagnosis, and, in fact, are unusual, except as part of a more diffuse injury or inflammatory process.

Acute bursitis is characterized by a painful swelling, fluctuant or tense in consistency, with restriction of mobility according to the site of the affected bursa and the relations of tendons and muscles. Where the bursa is subcutaneous, little difficulty is experienced in making a diagnosis by inspection and palpation. The inflammation may be simple serous from trauma or repeated irritation, or suppurative following infected wounds. The acute variety tends to become chronic unless successfully treated.

Chronic bursitis is the result of irritation over a long period, or follows the acute form. There is a tendency for papillary outgrowths to spring from the wall of the bursa which may be completely filled and distended by them. The most common form of chronic bursitis is that involving the prepatellar bursa, known as *housemaid's knee*. This follows irritation induced by working in a kneeling position which leads to a serous effusion, distending the bursa. Pain is very slight or absent, in contrast to the acute inflammation. The bursa may form a swelling on the anterior surface of the knee as large as a tangerine. Occasionally, the effusion is re-

placed by fibrous bands between the walls so that the tumor mass feels firm or quite hard.

Granulomata

Tuberculosis of the bursæ is not common. It arises as a primary affection or by extension from underlying diseased muscles, tendons or bones. The bursa is distended, but nearly painless, so that the condition is often advanced before the patient seeks treatment. The content of the bursa is the characteristic yellow, cheesy tuberculous pus which escapes through sinuses often present at the patient's first examination. Tenderness may be elicited on pressure. Mixed infection with the ordinary pyogenic bacteria is a common occurrence; the clinical picture of an acute suppurative bursitis will then be present.

CHAPTER XIV

THE ABDOMEN

GENERAL CONSIDERATIONS

The forming of an accurate diagnosis of a patient suffering from an acute or chronic abdominal condition is of such great importance that too much stress cannot be laid upon the proper procedures, in order to consummate that end. Too often, exploratory laparotomies are performed for the purpose of determining a diagnosis. There are times, however, when an intra-abdominal exploration is entirely justified.

If the case has been referred by another physician, the disease should be well discussed with him and, if he is an accurate observer, his outline of the history in its minute details (when he had charge of the case) could, in the vast majority of instances, considerably aid the surgeon in forming a diagnosis. The early symptoms of the disease are usually first noted by the general practitioner or the patient himself, and it is only too obvious that one examination for the forming of a correct diagnosis is not often sufficient without the assistance of those who have seen the case before. Immediate and so-called "spot diagnosis" is, at times, to the point, but under ordinary conditions entirely unsafe. If possible, the use of morphin before the surgeon sees the case should be avoided, due to the veiling of a train of symptoms which might lead up to an accurate diagnosis. There is, indeed, often a strong temptation on the part of both practitioner and surgeon to allay the pain, and to "watch how things are going along for a while." An *early diagnosis*, especially in an acute abdominal condition, is absolutely essential and, as a rule, leads to a prompt and correct method of treatment. The application of physiology and anatomy should in all cases be considered, and the surgeon should always bear in mind the possibility of a non-surgical condition as the possible cause of the underlying abdominal affection.

AN ACUTE ABDOMINAL CONDITION

History

Age; Sex; Occupation; Married or Single

Present Illness.—Trace carefully and thoroughly the history of the present illness, starting, if possible, with the earliest symptom and working up to:

The presenting symptom, including date and hour of the day or night. Determine whether there is any relation between a preëxisting disease such as one of the acute infectious diseases, acute tonsillitis, typhoid fever, local infection or injury.

Onset.—Acute or gradual.

Pain.—Any connection with onset, location, type and shifting or radiation from the beginning of onset. Has it been increased on micturition or defecation, relieved by position or pressure and has it followed any strenuous exercise or

exertion? Is it in any way related to the ingestion of food (relieved or increased)? Has it followed any indiscretion in diet?

Vomiting.—Type, relation to food, frequency and method of expulsion, relation to pain (before, at the same time or some hours after), presence of blood, food particles or mucus; color.

Nausea.—Without vomiting.

Bowels and Bladder.—Time of last movement, diarrhea or constipation, presence of blood (bright red or tarry or pasty in color). Has action of bowels been different than usual for the past few days or hours? Time of last urination and appearance of urine (bloody, brown, muddy). Has “gravel” been passed in urine?

Menstrual History.—Date of last period, painful or not. Has flow been increased or diminished, and has there been any vaginal bleeding between periods? Dates. Cessation of menstruation and when. Vaginal discharge, quantity.

Shock or fainting, as noted by patient or witness, and relation to onset.

Personal History.—At times, the patient will be too ill to give a complete and accurate past history but, if possible, determine the following: Alcoholic, venereal and menstrual history; serious previous illnesses, such as an acute infectious or contagious disease, acute tonsillitis, local infections, injury; and obtain all dates if possible. Former attacks of “acute” and “chronic indigestion” and so-called attacks of “appendicitis.” Previous abdominal operations.

Jaundice, and history of “gall-stone” or “kidney colic” and the passing of “gravel” in urine or stones by rectum.

Constipation, diarrhea, difference in color and shape of stools, and relation to previous attack. Previous passing of blood in urine or stools (dark or bright red). Loss of weight and appetite. Develop, if possible, the sequence of events in previous attacks with dates.

Physical Examination.—Facial expression and signs of shock. Pulse; temperature; respirations. General appearance, including color of mucous membranes, decubitus and position of knees, color of skin and scleræ, type of breathing, excursions of nasal alæ, pupils (reaction to light and accommodation, size and equality). Thorax (contour and expansion upon breathing). Situation of apex beat. Reflexes (especially knee kicks). Thorough examination of heart and lungs. Rectal and vaginal examination.

Abdominal Examination.—The examination of the abdomen for the determination of a diagnosis of an abdominal condition, either within or without the peritoneal cavity, should be undertaken, in all cases, with the utmost care and precision, and it is incumbent upon the physician or surgeon to bring to his command all symptoms ascertained by (1) inspection, (2) palpation, (3) percussion and (4) auscultation. When facts have thus been determined, the history of the case, together with the results obtained through a thorough physical examination and by the use of instruments of precision, should well complete or at least form a tentative diagnosis of the condition.

INSPECTION.—Note facial expression and attitude in bed and position of the knees. The examiner should inspect an abdomen under the best available light conditions and with the proper angulations. Good light is often as indispensable to the examiner as the deft finger, and accurate observation as to what the surgeon sees is as important, in many cases, as to what he feels. The patient should be

in a correct position of dorsal decubitus, near the edge of bed if possible, affording as much ease as is possible for the examiner, at the same time considering the comfort of the patient. The position should be such as to allow of change of posture to the lateral, erect or sitting position, depending upon the varied facts to be ascertained.

The main points which should be noted by abdominal inspection are:

1. Color and general condition of skin and subcutaneous tissues; such as redness, lemon hue, jaundice, bronzing, anemia, malnutrition, tenseness and glossiness, presence of rashes and eruptions, skin tumors, and induration (including signs of inflammation). Loss of abdominal fat.
2. Shape and symmetry.
3. Dilatation of the superficial abdominal wall veins or the formation of the caput medusæ (which may indicate obstruction in the portal circulation if central, and in the inferior vena cava, if lateral).
4. Hernial protrusions or diastasis of the recti muscles, as the result of repeated pregnancies.
5. Abdominal protuberances.
6. Wounds or abrasions.
7. Abdominal respiratory movements.
8. Visible rigidity of the abdominal muscles or retraction of the abdomen with inspiration.
9. Pulsation (epigastric or in other abdominal areas).
10. Peristaltic waves, visible peristalsis and direction of the waves, or such outlines (mounds) as indicate prominence of intestinal coils, stomach, etc.
11. Apparent condition of the umbilicus (displaced, retracted, projecting or discharging pus).
12. Swelling about groin or femoral regions and enlargement of inguinal or femoral lymph glands.

PALPATION.—Abdominal palpation is of the greatest importance and should, if possible, be carried on in a warm room with as little exposure of the patient as is possible and with the examiner's hands free from chill and, indeed, warmed before the examination. Care and consideration on the part of the examining physician will lend more confidence to the patient, who in turn will endeavor to coöperate more freely in the examination to follow. It is well, if possible, to converse with the patient a moment before palpating, and, perhaps, while learning something of the history of the case, the clothing or bedding can be so arranged that the patient will not be conscious of the exposing of the abdomen. Too much stress cannot be laid upon the poor effect of exposing more of the patient's body than is absolutely necessary, though care should be used in giving a sufficient abdominal bareness for a very thorough and complete examination. The ensiform cartilage above (level of), and the upper margin of the pubic hair line below, should be the upper and lower borders of exposure.

When a large area such as the abdomen demands palpation, a dorsal decubitus with the knees slightly or fully flexed is desired. The whole hand, including the palm, is to be employed in the beginning. Start gently and very lightly by placing the palm on the abdomen. *Always bear in mind the importance of*

avoiding the sensitive area (if suspected) *to the last*. The fingers are then slightly flexed without moving the palm until a satisfactory examination has been made with the flat or balls of the fingers; the palm is then moved from one to another of the abdominal areas. As a rule, the index, middle and third fingers are used, the little finger rarely being employed. For minute detail, the near tips of the fingers will elicit more than the entire hand. It is surprising how much knowledge may be derived from the light method of palpation. Abdominal muscle tone, pulsations, areas of hyperesthesia and the most slightly elevated intestinal mounds or tumors are often detected.

Moderate and deep palpation should follow the light and here, too, care and gentleness are of the utmost importance, avoiding rough pressure. Deep palpation will more easily elicit the contour, shape, size and consistency of a mass or localized inflammation while pulsation and thrill may be more easily obtained than with light palpation. For the determination of liver and spleen enlargement, for possible notation of the contour of the surface, deep palpation is necessary, reinforced at times by the other hand pressing down upon it.

When ascites is present, the edge of the liver can best be felt by dipping downward with the tips of the fingers (*ballotement*). Intra-abdominal tumors and, at times, the gall-bladder may also be detected in this manner. If a considerable amount of free intraperitoneal fluid is present, palpation may aid in its detection. This is accomplished by an assistant placing the ulnar edge of his hand firmly upon the linea alba while the examiner places one hand on one of the lateral abdominal walls while the fingers of the other hand tap sharply upon the opposite side. If fluid is present, a transmitted wave is felt by the palpating hand which had been placed upon the lateral abdominal wall; at times, this wave is also visible. It should be remembered that a large amount of abdominal fat or an atonic abdominal wall may give the same apparent *wave transmission*. This factor should always be considered.

For the detection of deep-seated tumor formations or for the outline of a kidney, *bimanual examination* may be used. One hand is placed under the patient and one on the abdomen, and while the patient is taking a deep breath the opposing hands are gradually brought together. The chief points to be derived from abdominal palpation are:

1. Detection of ascites.
2. Elicitation of the condition of the abdominal muscles (rigid, relaxed, flabby).
3. Detection of encysted fluid.
4. Detection of the presence of a tumor or mass, including range of mobility.
5. Sites of tenderness.
6. Condition of the abdominal walls.
7. Condition of possible hernial sites.
8. Peristaltic waves and mounds.
9. Succussion wave.
10. Pulsation and thrill.
11. Location of intra-abdominal organs.

Percussion.—In abdominal examinations, light, deep and auscultatory percussion may be used. The chief points to be derived from abdominal percussion are :

1. The outline of intra-abdominal organs.
2. Detection of fluid by shifting dullness.
3. Elicitation of deep tenderness.
4. Determination of the nature of an intra-abdominal mass and its relation to air-containing viscera.
5. Mapping out of *Traube's semilunar space*. (Traube's space is that area in the left upper abdominal quadrant, in which the stomach is covered by the ribs alone, and is bounded above and to the sides by the contiguous borders of the liver, lungs and spleen.) Normally this area offers a tympanic note.

INTERPRETATION OF HISTORY

Age.—Though not a definite determining factor, there are periods in which the incidence of certain conditions is most pronounced. Therefore it is incumbent upon the examiner to look upon age as being a most important item in the consideration of surgical conditions leading up to the presenting symptom of acute abdominal pain. In the *infant*, intussusception generally appears under the age of two, while acute gastro-enteritis and enteritis are common. Appendicitis, though uncommon in the infant, has been noted; the child of more advanced years, however, is more prone to the disease. Indeed, it may be said that appendicitis is seldom met with in infancy though it does occur. Bladder calculus might present. Strangulated hernia should always be considered at this age, though it is not as common as in later childhood. In *childhood*, appendicitis is common, as is also strangulated hernia. Acute pyelitis, though often not presenting acute abdominal signs, may give rise to symptoms and signs similar in many respects to acute appendicitis, and the ensuing acute cystitis may exhibit signs and symptoms similar in many respects to an acute pelvic peritonitis. Acute pneumococcic peritonitis is, in this age, most commonly found. The ovarian cyst with twisted pedicle though uncommon at this age does, at times, occur. The acute exanthemata are common (abdominal symptoms). *Young adults* are frequently affected with appendicitis, epididymitis with invasion of the spermatic cord, tuberculous peritonitis, acute salpingitis and acute gastro-enteritis. In *adult life* before the age of thirty, acute appendicitis, acute gastritis, gastric ulcer with or without perforation are common, while acute cholecystitis, acute pyelitis and acute diverticulitis (Meckel's) are often encountered. Obstruction of the bowels (benign or malignant stricture) is seldom met with before the age of thirty, is infrequent before forty, and most commonly seen after the age of forty. Acute pancreatitis, though occasionally presenting in the young adult, usually shows itself in those who have passed the age of thirty-five or forty, while duodenal ulcer with or without perforation is seldom seen before thirty, and most commonly after forty. The young adult may be affected with acute cholecystitis and with cholelithiasis but it should be considered as a disease most frequently encountered in one past thirty and most commonly after forty. Coronary thrombosis and angina pectoris are essentially

diseases occurring between the ages of forty to sixty-five. In the *childbearing* period one must always consider acute pelvic inflammation with its frequent abscess formation, together with ectopic pregnancy. Renal disturbances, such as the acute pyelitis of pregnancy, hydronephrosis, pyonephrosis and renal calculi, are not uncommon; indeed, the acute pyelitis of pregnancy is very frequent. The ovarian cyst with twisted pedicle is generally found in those past thirty. In *advanced age*, intestinal obstruction due to cancerous stricture, acute hernial strangulation and volvulus are most commonly found. Coronary thrombosis should always be considered as a possibility.

Sex is an important factor in the consideration of ectopic pregnancy, pelvic inflammatory disease, ovarian cysts with twisted pedicle, ureteral stricture and the acute pyelitis so frequently encountered in pregnancy.

Occupation.—The lead worker, the cook and the cobbler may enter into the differential diagnosis of lead colic and gastric ulcer.

Married or Single.—Applies most especially to ectopic pregnancy and pelvic inflammatory disease, though too much reliance should not be given to this phase. It is, however, important.

Family History.—Too much credence should not be placed on any family history, though naturally one is disposed toward the recognition of the hereditary diseases such as tuberculosis, carcinoma, syphilis and cardiac affections.

Personal History.—An *alcoholic history* may add some light as to the possibility of an acute gastro-enteritis, duodenal ulcer or acute pancreatitis.

Venereal history may bring before us the possibility of a coronary thrombosis, tabes dorsalis (with girdle pains) and ectopic pregnancy, which is of such common occurrence in the syphilitic.

Menstrual history most especially applies to ectopic pregnancy in which there is often seen a cessation of menstruation or the appearance of bleeding shortly before or during the attack. Many cases of ectopic pregnancy are, however, free from the history of one or the other.

Habit of Bowels and Bladder.—Chronic constipation or diarrhea are often met with in acute appendicitis and in an early intestinal stricture, either benign or malignant. Bear in mind the possibility of typhoid fever and the acute infectious diseases when there is a derangement of the bowels. If there is pain or irritation in the suprapubic region after urinating or during its act, consider the possibility of the existence of a pelvic abscess due to one of many causes. This also applies to pain upon defecation.

Former attacks of acute or chronic indigestion and of so-called “attacks of appendicitis.” The frequency with which a patient includes in his history “attacks of acute or chronic indigestion and of appendicitis” bears strong evidence of the existence of an appendical, a gastric, enteric or gastro-enteric affection. Appendicitis, duodenal and gastric ulcers most commonly give a history of some type of gastric or intestinal disturbance over a long period of time, but a negativeness should not rule out the presence of one of these conditions. Gastric malignancy cases usually present signs and symptoms in their history referable most especially to the stomach, while intestinal malignancy tends toward an accentuation of the intestinal signs and symptoms. At times, the acute pancreatic disturbance may be preceded by digestive disorders. (Often this is not

the case.) Gall-bladder and liver diseases are nearly always preceded by some type of indigestion.

Former Jaundice.—While this symptom in itself should not be considered as of too much importance, it must be remembered that duodenitis, cholangitis, and cholecystitis with or without calculi, and common duct calculi, very often give rise to jaundice shortly or long before an acute abdominal condition presents. See chapter on “Affections of Liver, etc.”

Melena or the passing of blood in the stools is a factor which, when accurately determined, may lead to the most illuminating aid in the forming of a diagnosis. In the first place, the observer should accurately determine whether the stools have been bright red or tarry, the time and frequency of appearance and its relation, if any, to the presence of pain. Unsatisfactory and inaccurate observations, however, regarding the passing of blood per rectum are misleading, and often too much reliance is placed upon the sign as ordinarily given by the patient. Frequently the patient will tell the physician that she is passing blood by stool, believing that a marked blackishness of the movement is due to blood, while as a matter of fact it may be nothing but the result of chemical coloring due to medication; this especially applies, as is well known, to the bismuth preparations. Always examine the rectum to be sure that the bleeding is not coming from hemorrhoids. Examination of the stools, to be of any use, must ordinarily be made persistently over a long period of time and accurate observations must be made as to whether the appearance of the blood in the stools continues or is intermittent. When, after proper dietary precautions have been employed, it has been determined definitely that blood has been found in the stools, the appearance of bright red blood is usually an indication of rectal varicosities, a tumor of the rectum or one low down in the sigmoid. Occasionally, acute and chronic diverticulitis of the sigmoid may exhibit the passing of red blood.

The presence of tarry stools often signifies gastric or duodenal ulcer, with or without perforation, gastric carcinoma, acute intestinal stenosis, either benign or malignant, intussusception, volvulus and esophageal varix.

In gastric ulcer, melena is less frequent than is hematemesis, while in duodenal ulcer it is the reverse and often disappears during the rest period, as opposed to carcinoma, in which the melena remains over a period of days, even during the stage of rest. In the duodenal ulcer, gastralgie attacks are often followed by melena; while in gastric carcinoma this symptom seems to have no relation between attacks of pain and the passing of blood. In advanced stages of carcinoma of the stomach, the persistency of melena is noteworthy.

Change of Color of Stools.—See chapter on “Affections of Liver, etc.”

Vomiting.—This symptom is of such common occurrence in patients presenting an acute abdominal condition that one almost takes for granted that vomiting will occur, either as a symptom directly related to a viscus, or as a reflex from the peritoneum. The type of vomitus most especially refers to whether it contains blood, bile, large amounts of mucus and undigested foods, while the time of its appearance is related to its following immediately the intake of food or shortly thereafter, or time independent of food ingestion. Frequency may be the determining factor in the acute abdominal case. The severe, prolonged and persistent vomiting in acute pancreatitis is as typical of that disease as is the subsidence

of vomiting after a perforation of a gastric ulcer. Early and persistent vomiting is common in gut strangulation and cyst and omental torsions. The coincidence of vomiting with pain is frequently found in a very acute peritonitis, twisting of the omentum, mesentery or cyst, acute ureteral calculus, and in obstruction of the bile-ducts. In intestinal obstruction, it should be remembered that the length of time before vomiting is some indication as to how high up in the gut the obstruction may be. Thus in the lower end of the ilium, vomiting may not come on for hours; in the large gut it may be a very late sign, though nausea may be present early. In obstruction, high up, vomiting is frequent and copious. In appendicitis, pain is usually present long before vomiting. In this disease the pain rarely starts after the vomiting. Frequent vomiting late in the course of an appendicitis case is, as a rule, a sign of an extension of a peritonitis.

ACUTE ABDOMINAL PAIN

<i>Infancy and Childhood</i> (Any Quadrant)	
A. Circulatory system	C. Genito-urinary system
I. Pericarditis, acute	I. Bladder
B. Digestive system	(a) Calculus
I. Intestines	(b) Cystitis
(a) Appendicitis (acute)	(c) Distention
(b) Diverticulitis, Meckel's (acute)	II. Kidney
(c) Enteritis (acute)	(a) Infarct
(d) Foreign bodies	(b) Pyelitis (acute)
(e) Gastro-enteritis	III. Ovary
(f) Enteritis (tuberculous)	Cyst with twisted pedicle
(g) Hirschsprung's disease	D. Nervous system
(h) Impaction (fecal)	I. Meningitis (acute epidemic)
(i) Infectious diarrhea (acute)	II. Meningitis (acute pyogenic)
(j) Intestinal obstruction	III. Meningitis (tuberculous)
1. Congenital	IV. Hysteria
i. Bands	V. Tetanus
ii. Malformations	E. Osseous system
2. Inflammatory	I. Hip (tuberculosis)
3. Impaction (fecal)	II. Spinal column (tuberculosis)
4. Intussusception	F. Pulmonary system
5. Strangulation of diverticulum (Meckel's)	I. Pleurisy
6. Strangulated hernia	II. Pneumonia
7. Tuberculosis	G. Injury to abdominal wall, viscus or both, with or without perforation
8. Tumors (benign and malignant)	H. Acute infectious and other diseases
II. Mesentery	I. Measles
(a) Adenitis (acute)	II. Henoch's purpura
(b) Tabes mesenterica	III. Scarlet fever
III. Stomach and duodenum	IV. Typhoid fever
(a) Pyloric spasm	
(b) Pyloric stenosis (congenital)	<i>Acute Diffuse Abdominal Pain</i>
(c) Foreign bodies	A. Circulatory system
(d) Tumors (usually benign)	I. Abdominal aneurysm
(e) Ulcer (rare)	II. Angina pectoris
IV. Peritoneum	III. Coronary thrombosis
(a) Inflammation (acute pyogenic)	IV. Pericarditis (acute)
(b) Inflammation (acute pneumococic)	V. Rupture of an abdominal artery
(c) Tuberculosis	

ACUTE ABDOMINAL PAIN (*Continued*)*Acute Diffuse Abdominal Pain (Continued)*

B. Digestive system

I. Intestines

- (a) Appendicitis (acute)
- (b) Colitis (acute)
- (c) Diverticulitis (acute)
- (d) Enteritis (acute)
- (e) Enteritis (tuberculous)
- (f) Gastro-enteritis (acute)
- (g) Intestinal obstruction

- 1. Adhesions (inflammatory, postoperative, tuberculous)
- 2. Concretions and foreign bodies
- 3. Congenital bands and malformations
- 4. Impaction (fecal)
- 5. Intussusception
- 6. Strangulation of diverticulum
- 7. Strangulated hernia (external or internal)
- 8. Tumors (benign and malignant)
- 9. Volvulus

(h) Perforation or rupture

II. Liver, gall-bladder and bile-ducts

- (a) Cholecystitis (acute)
- (b) Cholelithiasis (impacted or with infection)
- (c) Common duct calculus (impacted)
- (d) Perforation or rupture of gall-bladder

III. Mesentery and omentum

- (a) Adenitis (acute)
- (b) Torsion of cyst
- (c) Thrombosis of mesenteric vessels
- (d) Torsion of omentum

IV. Pancreas

Pancreatitis (acute)

V. Peritoneum

- (a) Inflammation (acute pyogenic)
- (b) Inflammation, gonorrheal or pneumococcic
- (c) Tuberculosis
- (d) Rupture of abscess into free peritoneal cavity

VI. Stomach and duodenum

Perforation (traumatic or ulcerative)

C. Genito-urinary system

I. Bladder

- (a) Calculus
- (b) Distention
- (c) Perforation or rupture

II. Kidney

- (a) Calculus
- (b) Infarct
- (c) Pyelitis (acute or pyonephrosis)
- (d) Hydronephrosis with torsion of pedicle

III. Ovary and fallopian tube

- (a) Cyst with twisted pedicle
- (b) Ectopic gestation
- (c) Perforation or rupture of pyosalpinx
- (d) Salpingitis (acute)

IV. Uterus

- (a) Pregnancy
- (b) Perforation or rupture

D. Nervous system

I. Hysteria

II. Meningitis (acute epidemic)

III. Meningitis (acute pyogenic)

IV. Meningitis (tuberculous)

V. Tabes dorsalis

VI. Tetanus

VII. Tumors of spinal cord

E. Pulmonary system

I. Pleurisy (especially diaphragmatic)

II. Pneumonia

F. Injury to abdominal wall, viscus or both and with or without perforation

G. Acute deficiency of adrenal glands (Addison's disease)

H. Lead poisoning

I. Acute infectious and contagious diseases

I. Influenza

II. Measles

III. Scarlet fever

IV. Typhoid fever

Right Upper Abdominal Quadrant

A. Circulatory system

I. Angina pectoris

II. Coronary thrombosis

B. Digestive system

I. Intestines

- (a) Appendicitis (acute retrocecal)
- (b) Enterocolitis (acute)
- (c) Megalocolon
- (d) Intestinal obstruction

- 1. Adhesions (inflammatory, postoperative, tuberculous)
- 2. Congenital bands and malformations
- 3. Tumors (benign and malignant)
- 4. Volvulus of hepatic flexure

ACUTE ABDOMINAL PAIN (*Continued*)

<i>Right Upper Abdominal Quadrant (Cont.)</i>	<i>Epigastric Region</i>
B. Digestive system (<i>Continued</i>) II. Liver, gall-bladder and bile-ducts (a) Abscess of liver (b) Acute yellow atrophy (rare with pain) (c) Calculus (liver) (d) Congestion (acute of liver) (e) Cyst of liver (echinococcus) (f) Gumma of liver with degeneration (g) Perihepatitis (acute) (h) Phosphorus poisoning (i) Pylephlebitis (may be no pain) (j) So-called "wandering liver" (k) Gall-bladder 1. Cholecystitis (acute) 2. Cholelithiasis (impacted or with infection) 3. Pericholecystitis (acute) 4. Rupture or perforation III. Pancreas Pancreatitis (acute) IV. Stomach and duodenum (a) Duodenal carcinoma (b) Duodenal ulcer (c) Pyloric carcinoma (d) Pyloric ulcer C. Genito-urinary system I. Kidney (a) Abscess (b) "Apoplexy" into perirenal tissues (c) Calculus (d) Contusion (e) Floating, with torsion of pedicle (f) Hypernephroma (g) Perinephritic abscess (h) Pyelitis (acute) and pyonephrosis (i) Retroperitoneal sarcoma (j) Rupture II. Ovary Cyst with twisted pedicle D. Pulmonary system I. Pleurisy including diaphragmatic II. Pneumonia E. Nervous system I. Herpes zoster II. Intercostal neuralgia F. Subphrenic abscess G. Malaria and recurrent fever	A. Circulatory system I. Angina pectoris II. Coronary thrombosis III. Dilatation of heart (acute) B. Digestive system I. Intestines (a) Appendicitis (acute) (b) Any inflammatory lesion may show as reflex in this region II. Liver, gall-bladder and bile-ducts (a) Cholangitis (acute) (b) Cholelithiasis (acute; with impaction or infection) (c) Common bile-duct calculus (impacted) (d) Calculus in ampulla of Vater III. Stomach and duodenum (a) Dilatation of stomach (acute) (b) Duodenal ulcer (with or without perforation) (c) Gastric ulcer (with or without perforation) (d) Gastritis (acute) (e) Perigastric abscess (f) Pyloric obstruction (varied etiology) (g) Pyloric spasm (h) Tumors (benign and malignant without obstruction) IV. Pancreas (a) Cyst (b) Pancreatitis (acute) C. Genito-urinary system Floating kidney with twisted pedicle D. Pulmonary system I. Diaphragmatic pleurisy II. Pneumonia E. Nervous system I. Neurosis II. Tabes dorsalis F. Osseous system Pott's disease G. Hernia I. Diaphragmatic II. Epigastric (with or without incarceration or strangulation) H. As a reflex from any peritoneal irritation <i>Left Upper Abdominal Quadrant</i> A. Circulatory system I. Angina pectoris II. Coronary thrombosis III. Dilatation of heart (acute)

ACUTE ABDOMINAL PAIN (*Continued*)*Left Upper Abdominal Quadrant (Continued)*

B. Digestive system

I. Intestines

- (a) Enterocolitis (acute)
- (b) Megalocolon
- (c) Intestinal obstruction
 - 1. Adhesions (inflammatory, postoperative, tuberculous)
 - 2. Congenital bands and malformation
 - 3. Tumors (benign and malignant)
 - 4. Volvulus, splenic flexure

II. Pancreas

- (a) Cyst
- (b) Pancreatitis (acute)

III. Stomach

- (a) Dilatation (acute)
- (b) Gastric ulcer with or without perforation
- (c) Gastritis (acute)
- (d) Perigastric abscess
- (e) Tumors (benign and malignant without obstruction)

C. Genito-urinary system. See "Acute Pain in Right Upper Abdominal Quadrant"

D. Pulmonary system. See "Acute Pain in Right Upper Abdominal Quadrant"

E. Nervous system. See "Acute Pain in Right Upper Abdominal Quadrant"

F. Spleen

I. Abscess

II. Infarct

III. Splenitis (acute)

IV. Cyst with infection

G. Subphrenic abscess

H. Malaria and recurrent fever

Right Lower Abdominal Quadrant

A. Digestive system

I. Intestines

- (a) Appendicitis (acute)
- (b) Carcinoma of appendix
- (c) Cysts of appendix
- (d) Tuberculosis of appendix
- (e) Actinomycosis of appendix
- (f) Diverticulitis Meckel's (acute)
- (g) Colitis (acute)
- (h) Enterocolitis (acute)
- (i) Intestinal obstruction
 - 1. Adhesions (inflammatory, postoperative, tuberculous)
 - 2. Congenital bands and malformations
 - 3. Enteroliths

4. Intussusception

5. Tumors of cecum (benign and malignant)

II. Perforation of typhoid ulcer

III. Mesentery and omentum

- (a) Mesenteric cyst
- (b) Torsion of omentum

B. Genito-urinary system

I. Kidney

- (a) Calculus
- (b) Pyelitis (acute) or pyonephrosis
- (c) Torsion of pedicle (hydronephrosis)
- (d) Tumors (benign and malignant)

II. Ureter

- (a) Calculus
- (b) Spasm
- (c) Tumors (benign and malignant)

III. Ovary and fallopian tube

- (a) Cyst with twisted pedicle
- (b) Ectopic gestation
- (c) Parovarian abscess
- (d) Pelvic inflammatory disease (diffuse)
- (e) Pyosalpinx (acute)
- (f) Salpingitis (acute)

IV. Testicle, epididymis and spermatic cord

- (a) Epididymitis (acute)
- (b) Orchitis (acute)
- (c) Spermatic cord (acute inflammation)
- (d) Spermatic cord (torsion)
- (e) Testicle (torsion of undescended testicle)
- (f) Tumors (malignant of undescended testicle)

C. Osseous system

I. Hip (tuberculosis of)

II. Pott's disease

D. Strangulated hernia (external and internal)

E. Typhoid fever

F. Inguinal adenitis (acute)

Suprapubic Region

A. Digestive system

I. Intestines

- (a) Appendicitis (acute)
- (b) Enterocolitis

CHRONIC ABDOMINAL PAIN

*Suprapubic Region (Continued)*A. Digestive system (*Continued*)I. Intestines (*Continued*)

- (c) Diverticulitis
- (d) Intestinal obstruction
 1. Adhesions (inflammatory, postoperative, tuberculous)
 2. Congenital bands and malformations
 3. Enteroliths
 4. Strangulated hernia (especially direct)
 5. Tumors (sigmoid, rectum and ileum)

B. Genito-urinary system

I. Bladder

- (a) Calculus
- (b) Cystitis
- (c) Distention (paralytic and obstructive)
- (d) Foreign bodies
- (e) Rupture
- (f) Infiltration of urine
- (g) Abscess (space of Retzius)
- (h) Instrumentation
- (i) Strangulated bladder hernia

II. Ureter

- (a) Calculus
- (b) Spasm
- (c) Stricture (organic)

III. Uterus and adnexa

- (a) Abortion, miscarriage and labor
- (b) Abscess, pelvic (varied etiology)
- (c) Inflammation (gonorrheal, pyogenic)
- (d) Perforation of uterus

- (e) Ruptured uterus
- (f) Cyst with torsion of pedicle
- (g) Tumors (malignant)
- (h) Pregnancy

C. Osseous system

I. Injuries of bony pelvis

II. Tumors of bony pelvis

Left Lower Abdominal Quadrant

A. Digestive system

I. Intestines

- (a) Appendicitis (acute; rare)
- (b) Diverticulitis
- (c) Colitis
- (d) Intestinal obstruction
 1. Adhesions (inflammatory, postoperative, tuberculous)
 2. Congenital bands and malformations
 3. Diverticulum
 4. Enteroliths
 5. Intussusception (rare)
 6. Stricture (sigmoid or rectum)
 7. Tumors (benign and malignant)
 8. Strangulated hernia
 9. Volvulus
- (e) Sigmoiditis and perisigmoiditis

II. Mesentery and omentum

- (a) Mesenteric cyst
- (b) Torsion of omentum

B. Genito-urinary system. See "Right Lower Abdominal Quadrant"

C. Osseous system. See "Right Lower Abdominal Quadrant"

CHRONIC ABDOMINAL PAIN

Right Upper Abdominal Quadrant

A. Circulatory system

Aneurysm of renal artery

B. Digestive system

I. Intestines

- (a) Chronic appendicitis (retrocecal)
- (b) Chronic colitis
- (c) Malignant tumor of colon
- (d) Malignant tumor of duodenum
- (e) Intestinal obstruction (partial)
 1. Adhesions (inflammatory, postoperative, tuberculous)

- 2. Congenital bands and malformations
- 3. Diverticulum
- 4. Enteroliths
- 5. Incarcerated internal hernia
- 6. Tumors of colon, benign and malignant
- 7. Volvulus (partial) of hepatic flexure (rare)

II. Liver, gall-bladder and bile-ducts

(a) Liver

- 1. Chronic abscess
- 2. Amyloid disease
- 3. Banti's disease
- 4. Cirrhosis

*Right Upper Abdominal Quadrant (Cont.)*B. Digestive system (*Continued*)II. Liver, gall-bladder and bile-ducts (*Continued*)(a) Liver (*Continued.*)

5. Congestion (chronic passive)
6. Corset liver
7. Cyst
8. Hodgkin's disease
9. Leukemia
10. Syphilis
11. Tumors (carcinoma and sarcoma)

(b) Gall-bladder

1. Chronic cholecystitis
2. Chronic pericholecystitis
3. Cholelithiasis
4. Tumors (malignant)

III. Pancreas

- (a) Calculus
- (b) Chronic pancreatitis
- (c) Cyst
- (d) Tumors (malignant)

IV. Stomach and duodenum

- (a) Achylia gastrica
- (b) Chronic perigastritis
- (c) Chronic duodenitis
- (d) Chronic duodenal ulcer
- (e) Chronic gastric ulcer
- (f) Syphilis
- (g) Chronic gastritis

C. Genito-urinary system

I. Calculus (renal)

II. Calculus (ureteral)

III. Hypernephroma

IV. Movable kidney

V. Pyelitis (chronic) and pyonephrosis (chronic)

VI. Tuberculosis of adrenal gland

VII. Tuberculosis of kidney

VIII. Tumors (benign and malignant)

D. Nervous system

Intercostal neuralgia or neuritis

E. Osseous system

Tumors of ribs (benign and malignant)

F. Pulmonary system

Chronic pleurisy

G. Peritoneum

Postoperative adhesions

H. Subdiaphragmatic abscess (chronic)

I. Hernia (ventral)

Epigastric Region

A. Circulatory system

I. Aneurysm (abdominal)

II. Aneurysm (thoracic)

III. Chronic passive congestion of liver

B. Digestive system

I. Intestines

(a) Duodenitis (chronic)

(b) Duodenal ulcer

(c) Enteroptosis

(d) Malignant tumor of transverse colon

(e) Malignant tumor of duodenum

(f) Transverse colon disease, inflammatory

II. Liver, gall-bladder and bile-ducts

(a) Liver

1. Abscess of left lobe

2. Cirrhosis

3. Cyst

4. Gumma of left lobe

(b) Gall-bladder

1. Chronic cholecystitis

2. Chronic pericholecystitis

3. Malignant tumors

III. Esophagus

(a) Strictures (inflammatory and syphilitic)

(b) Tumors

IV. Pancreas

(a) Calculus

(b) Chronic pancreatitis

(c) Cyst

(d) Tumors (malignant)

V. Stomach

(a) Achylia gastrica

(b) Chronic gastritis

(c) Chronic gastric ulcer

(d) Syphilis

(e) Tumors (benign and malignant)

C. Peritoneum

Adhesions (varied etiology)

D. Hernia

I. Diaphragmatic

II. Epigastric

F. Pernicious anemia

F. Pulmonary tuberculosis

Left Upper Abdominal Quadrant

A. Circulatory system

I. Aneurysm of renal artery

II. Aneurysm of splenic artery

III. Aneurysm of thoracic aorta

CHRONIC ABDOMINAL PAIN (*Continued*)*Left Upper Abdominal Quadrant (Continued)*

B. Digestive system

I. Intestines

- (a) Chronic colitis
- (b) Chronic diverticulitis
- (c) Malignant tumor of colon (non-obstructive)
- (d) Intestinal obstruction (partial). See "Right Upper Abdominal Quadrant"; also Volvulus (partial) of splenic flexure

II. Pancreas. See "Right Upper Abdominal Quadrant"

III. Stomach. See "Right Upper Abdominal Quadrant"

C. Genito-urinary system. See "Right Upper Abdominal Quadrant"

D. Nervous system. See "Right Upper Abdominal Quadrant"

E. Osseous system. See "Right Upper Abdominal Quadrant"

F. Pulmonary system. See "Right Upper Abdominal Quadrant"

G. Peritoneum. See "Right Upper Abdominal Quadrant"

H. Subdiaphragmatic abscess

I. Spleen

- (a) Amyloid disease
- (b) Banti's disease
- (c) Chronic passive congestion
- (d) Chronic perisplenitis
- (e) Chronic splenitis
- (f) Cysts and parasitic disease
- (g) Gaucher's disease
- (h) Hodgkin's disease
- (i) Malaria
- (j) Polycythemia
- (k) Post-typhoid
- (l) Recurrent fever
- (m) Tumors (benign and malignant)

J. Hernia (ventral)

Right Lower Abdominal Quadrant

A. Circulatory system

I. Thrombosis of iliac artery

II. Thrombosis of iliac vein

III. Aneurysm of iliac artery

B. Digestive system

I. Intestines

- (a) Actinomycosis of appendix and cecum

(b) Chronic appendicitis

(c) Chronic diverticulitis (Meckel's)

(d) Tuberculosis of appendix

(e) Tuberculosis of cecum

(f) Tuberculous enteritis

(g) Tumors of appendix and Meckel's diverticulum (benign and malignant)

(h) Enterocolitis, including amebic dysentery

(i) Impacted cecum

(j) Intestinal obstruction (partial)

1. Adhesions (inflammatory, postoperative and tuberculous)

2. Congenital bands and malformations

3. Enteroliths

4. Intussusception (partial)

5. Tumors of cecum (benign and malignant)

C. Genito-urinary system

I. Kidney

(a) Calculus

(b) Chronic pyelitis or pyelonephrosis

(c) Movable kidney

(d) Tumors (benign and malignant)

(e) Suprarenal gland (hypernephroma)

II. Spermatie cord

(a) Hydrocele

(b) Varicocele

III. Ureter

(a) Calculus

(b) Stricture (inflammatory or from pressure without)

(c) Tuberculosis

(d) Tumors (benign and malignant)

IV. Uterus and adnexa

(a) Chronic pelvic inflammatory disease (chronic pyosalpinx, etc.)

(b) Ectopic gestation (without rupture)

(c) Intra-abdominal pregnancy

(d) Ovarian, parovarian and broad ligament tumors and cysts

(e) Uterine tumors (benign and malignant)

D. Osseous system

I. Tuberculosis of hip

II. Tuberculosis of spine with its complications

CHRONIC ABDOMINAL PAIN (*Continued*)

<i>Right Lower Abdominal Quadrant (Cont.)</i> E. Hernia I. Femoral II. Inguinal III. Ventral IV. Incarceration of an internal hernia F. Inguinal lymph glands I. Chronic inflammation II. Tuberculosis III. Tumors (malignant) G. Retroperitoneal tumor H. Tabes mesenterica I. Tuberculous peritonitis	IV. Prostate gland (a) Chronic prostatitis (b) Tumors (benign and malignant) C. Osseous system I. Chronic inflammatory condition of bony framework II. Injuries of bony pelvis III. Tumors of bony pelvis
<i>Suprapubic Region</i> A. Digestive system I. Chronic appendicitis (especially pelvic) II. Chronic diverticulitis III. Enterocolitis IV. Intestinal obstruction (partial). See "Right Lower Abdominal Quadrant" B. Genito-urinary system. I. Bladder (a) Calculus (b) Cystitis (c) Distention (chronic) (d) Diverticulum (e) Foreign bodies (f) Hernia (g) Tuberculosis (h) Tumors (benign and malignant) II. Ureter. See "Right Lower Abdominal Quadrant" III. Uterus and adnexa (a) Abscess (chronic) in culdesac (b) Chronic pelvic inflammatory disease (c) Pregnancy (d) Tumors (benign and malignant including cysts)	<i>Left Lower Abdominal Quadrant</i> A. Circulatory system I. Thrombosis of iliac artery II. Thrombosis of iliac vein III. Aneurysm of iliac artery B. Digestive system I. Intestines (a) Chronic colitis (b) Chronic sigmoiditis and perisigmoiditis (c) Diverticulitis (congenital, acquired) (d) Fecal impaction (e) Tumors of colon, sigmoid, rectum, and small intestine (benign and malignant) (f) Intestinal tuberculosis (g). Intestinal obstruction (including volvulus) (h) Megacolon (i) Appendicitis (chronic, left-sided) C. Genito-urinary system Same as "Right Lower Abdominal Quadrant" D. Osseous system Same as "Right Lower Abdominal Quadrant" E. Hernia Same as "Right Lower Abdominal Quadrant" F. Inguinal lymph glands Same as "Right Lower Abdominal Quadrant" G. Retroperitoneal tumor H. Tuberculous peritonitis

CHAPTER XV

THE ABDOMEN (*Continued*)

ABDOMINAL INJURY

History

Age; Sex; Occupation

Personal History.—Venereal and alcoholic history; malaria, bowel and bladder habit.

Present Illness.—Description of accident and time of injury; time of last urination and defecation. Hemoptysis and hematemesis, vomiting, pain (location, extent and character).

Physical Examination.—Contour of abdomen; type of breathing. Objective signs of shock; marks on external abdominal wall; icterus; hiccough; contraction of abdominal muscles; position of knees; spasm of cremaster muscles; tenderness and rigidity over costovertebral angle; general abdominal tenderness and rigidity; most pronounced sites of tenderness and rigidity; tenesmus and inability to withdraw urine through catheter; blood in urine and stools. Presence of fractured ribs, low down. Percussion for signs of free fluid and palpation for tumors. Ballance's sign (see "Injury of Spleen"). Crepitation of pelvic bones. Blood-count. Cystoscopy. Radiography.

Results of Abdominal Injury

Injury of abdominal wall	{	wounds
		sprain of abdominal muscles
		rupture of abdominal muscles
		contusion

Injury of gastro-enteric tract	{	contusion or rupture of stomach
		contusion or rupture of small intestine
		contusion or rupture of large intestine

Contusion or rupture of pancreas

Contusion or rupture of liver

Contusion or rupture of gall-bladder

Contusion or rupture of spleen

Injury of urinary tract	{	contusion or rupture of kidney
		contusion or rupture of ureter
		contusion or rupture of bladder

Tearing of mesentery

Contusion or rupture of diaphragm

Rupture of abdominal aorta or branches

Fractured pelvis

General Symptoms of Abdominal Injury.—Abdominal injuries are of two types, namely, penetrating and non-penetrating. The latter, in many cases, produce the same injuries to the underlying viscera as do the penetrating, the only difference in the symptom-complex being the absence of an abdominal wall wound. A perforation of a viscus with all its accompanying pathology, following, perhaps, a severe blow, occurs frequently without any traumatic sign other than as a rule the appearance of a pink or red spot or ecchymotic area over the site of the injury.

It should, therefore, be constantly borne in mind that the most violent kind of intra-abdominal injury may, and often does, occur without apparent trauma to the abdominal wall. In the penetrating variety, added to the symptoms following an intra-abdominal injury, we may have feces, urine, gas or bile escaping from the wound; protruding intestine or omentum or other intraperitoneal contents, depending upon the extent of the wound, may also appear. Severe bleeding from the wound is occasionally present.

Some degree of shock is present in all cases, primary minor constitutional disturbances often being followed in a short time by the most stormy symptoms. Let us, therefore, never be guided in our judgment of the extent of an intra-abdominal injury by the apparent paucity of shock symptoms. On the other hand, extreme shock, transitory in nature, may often be present from traumatic disturbances of the plexuses. It is safer, however, to look upon all cases of abdominal injury with suspicion of severe injury, watching our cases carefully, ruling in and excluding symptoms intelligently, and always remembering that the slightest error in judgment regarding exploration may turn the tide, and that when in doubt, it is far better to explore the abdomen rather than to rely upon the "possibility of the condition clearing up."

It is for this reason that a most careful examination of the patient, both from the standpoint of questioning, if possible, and thorough physical examination is imperative. Persistent pain, progressive rigidity of the abdominal muscles, signs of hemorrhage, including a rising pulse rate, are of sufficient importance to warrant exploration. Let us not wait for distention and tympanites with obliteration of liver dulness, dulness in flanks and severe late constitutional disturbances, before we resort to operative intervention. If bloody urine appears, or if the symptoms point to a contused or ruptured kidney, then we must think and consider twice, too, whether or not we should operate, for often a contused kidney will present signs and symptoms referable to the peritoneal cavity.

INTERPRETATION OF HISTORY

Personal History.—*Veneral, alcoholic, malarial* history. These predispose to rupture of the liver and spleen. It also must be considered that a patient may be hurt when drunk in which case probable distention of the bladder must be thought of.

Bowel and Bladder Habit.—It is always well to ascertain, if possible, the general habit so far as the bowels and bladder are concerned, in order to determine whether patient has probably defecated or urinated before the accident; this especially applies to rupture of the intestines and bladder.

Present Illness.—*Description of Accident and Time of Injury.*—This applies especially in differentiating between a crushing accident and one due to a puncture, perforated, bullet or gunshot wound. Time refers most especially in the computing of the amount of shock, hemorrhage and general damage done to the tissues, between the time of accident and the examination of the case.

Time of last urination and defecation, so as to gauge whether or not there was a full bladder or distended intestine at time of injury; thus, if a patient urinated very shortly before the accident or if there was a complete evacuation of the bowels just before injury, one would feel more justified in ruling out a rupture of the bladder or intestines, than if the patient had not urinated or defecated for some time previous.

Hemoptysis especially applies to the possible rupturing of the diaphragm with an accompanying rupture of the lung. At times this cannot be differentiated from the vomiting of blood.

Hematemesis especially applies to a wound of the stomach or a wound of the intestine high up. This symptom may, of course, be entirely absent.

Vomiting is a variable and frequent symptom and may be caused by any injury to the abdominal viscera though there may be no definite and severe injury to a viscus. It may simply imply a peritoneal irritation. It may be present after a kidney or bladder injury.

Pain.—*Location, Extent and Character.*—This is important, especially if localized and severe on motion, respiration and on pressure. Intense local and diffuse pain, sometimes referred to the shoulder, accompanies injuries to the liver, increased by deep breathing and coughing. Intense pain generally referred to the region of the spleen often denotes injury to the spleen. This, later, may become generalized.

Intense pain, especially referred to the kidney region, radiating down the course of ureter to bladder and external genitalia and along inner surface of thigh is common in injury to kidney.

Pain in suprapubic region is common in injury to the urinary bladder. Pain over epigastrium, which later may become diffused, is usually present in stomach injury.

Intense pain over the right lower abdominal quadrant, which perhaps later becomes diffused, is noted in rupture of the intestine near, or at the ileocecal valve. With a ruptured intestine, the pain may be the most acute in the region of the rupture. This is also true where there is a tearing of the mesentery.

Physical Examination.—*Signs of Shock and Hemorrhage.*—The amount of shock and signs of internal hemorrhage are variable and are not an absolute guiding point. They may follow the most severe, and even the slightest injuries to the peritoneal viscera. We must remember that a severe blow delivered over any of the great nerve-centers, such as the solar plexus, will give all the evidences of an extreme shock. Our judgment in making a differential diagnosis from this standpoint, therefore, must be guarded. Extreme shock, however, does, as a rule, follow the extreme injuries of the liver and spleen; this, however, may be said also of the tearing of a large mesenteric or renal vessel. Pallor, dyspnea, rapid and shallow pulse, restlessness, air-hunger, cold extremities, perhaps unconsciousness, are present in shock.

Contour of Abdomen.—See chapter on “Examination of Abdomen.” Distention is often late but it is a most valuable sign when it progresses and when it obliterates the liver dulness.

Type of Breathing.—See chapter on “Examination of Abdomen.”

Presence of icterus especially refers to a rupture of the gall-bladder, perhaps ruptured liver, or it occurs now and then in the presence of an intra-abdominal hemorrhage.

Hiccough is possibly present in a ruptured diaphragm or in presence of a pneumoperitonitis or infective peritonitis.

Contraction of Abdominal Muscles.—In abdominal injury this sign is often present over the site of an injured viscus and where hemorrhage has occurred. It is the most reliable of all signs and, if progressive, is practically conclusive.

Position of Knees.—Flexed knees often indicate peritoneal irritation. See “Examination of Abdomen.”

Spasm of cremaster muscles is frequent when there has been any violent trauma to the abdominal wall, but this symptom is most especially present when traumatic hernia has occurred or in injury to the genito-urinary tract, especially a ruptured bladder.

Tenderness and rigidity over costovertebral angle denotes a severe muscular lumbar injury or injury to the kidney.

Vesical tenesmus is usually found in injuries to bladder and lower abdomen and also in a severe contusion or ruptured kidney.

Inability to withdraw urine through catheter is often an indication of a ruptured bladder. Blood in the urine may be found in a contusion or laceration of the kidney, ureter, or bladder. It should be thoroughly borne in mind, however, that the absence of blood in the urine should not be proof that injury to the kidney or ureter has not occurred; occasionally a kidney or ureteral hemorrhage will be so profuse that by the time the urine is examined, the ureter has been so plugged with blood that there will be a complete absence of drainage from the affected side. Microscopic blood is usually found.

Bloody stools may be present in any simple or severe injury to the gastro-enteric tract.

Presence of fractured ribs, low down, often is an accompaniment of a ruptured diaphragm, liver, spleen and stomach.

Signs of free fluid may or may not be present in severe intraperitoneal hemorrhage, ruptured intestines or stomach.

Ballance's sign may be present. See “Injury of Spleen.”

Crepitation of pelvic bones is often present in injuries to bladder, lower intestines, ureter and iliac vessels.

Blood-Count.—Any hemorrhage or infection may cause an increase in the leukocytes.

A *cystoscopic examination* is of value in the determination of bladder, ureteral and kidney injuries.

Injury of Abdominal Wall

Wounds of the abdomen may be divided into three types:

1. Superficial parietal. A wound which extends through the skin and subcutaneous fat.
2. Deep parietal. A wound involving the muscles and aponeurosis and which opens up the intermuscular planes and deeper tissues.
3. Penetrating. A wound extending through the parietes into the peritoneal cavity.

Wounds of the abdomen may also be divided into the puncture, bullet, contused, lacerated and incised wounds.

The puncture wounds, which embrace those caused by bullets, give rise to difficulties in determining the extent of the damage inflicted; these are due to the smallness of the wound and the inability to obtain the weapon, bullet or instrument which caused the wound. It is important to inquire as to the kind and size of the instrument used, whether it remains in its entirety, whether it is stained with stomach or intestinal contents and, if a bullet, to ascertain its caliber.

A definite diagnosis as to the extent of the injury inflicted is often impossible without enlargement of the wound and further exploration.

Lacerated and incised wounds of the abdomen often give rise to the escape of intraperitoneal contents such as portions of a viscus, or of gas, feces, bile or urine. Under ordinary conditions, in this type of wound, it will not be difficult for the examiner to determine whether the wound is of the parietal or penetrating type.

Sprain of the Abdominal Muscles.—This condition usually exists without signs of external injury. It most commonly follows a quick muscular exertion or the result of a sudden impact by some large flat object upon the abdominal wall. The symptoms are those of abdominal soreness and lameness, especially on abdominal muscular exertion, particular movements giving rise to pain. Local tenderness is present. Occasionally, there is a slight boggy swelling over the muscle or muscles involved. Ecchymosis is often present.

Rupture of the abdominal muscles is rare but when occurring usually involves the recti, and most often follows a direct twist or pull, but it may be associated with injuries of adjacent parts. A symptom-complex includes an extensive blue-red discoloration with hematomatous formation, pain on pressure and on respirations, together with a definite palpable depression over site of muscle tear.

Contusion of Abdominal Wall.—This condition, *per se*, is not a very serious condition, but it should always be borne in mind that the possibility of intraperitoneal damage is great and the examiner should use utmost care in eliminating the possibility of visceral or blood-vessel rupture. As a condition limited to the abdominal wall alone, it may appear as a local or fairly diffuse affection.

If severe, variable degrees of shock, accompanied by difficulty in breathing, vomiting, pain and pallor are present. Total unconsciousness may ensue, due to trauma of the abdominal plexuses. A pink or red area is usually present over the site of impact, soon accompanied by ecchymosis and the formation of an hematoma, situated subcutaneously, intramuscularly and even properitoneally. At times,

signs of inflammation with the formation of an abdominal wall abscess may ensue days after the accident.

Injury of Gastro-enteric Tract

This includes contusions or rupture of the stomach and small and large intestines. Differential diagnosis of the above conditions is usually extremely difficult, the main importance lying in the ability of the examiner to determine whether the intra-abdominal injury is sufficiently severe to warrant exploration. The protrusion of the omentum or intestine through an external wound will necessarily assist in the forming of a correct diagnosis; the marked frequency of injury to a viscus without external signs of violence is so great that the presence of an abdominal wall wound is only, at times, of aid to the surgeon.

Localized epigastric pain and tenderness and muscular rigidity, accompanied by hematemesis, in a patient who has recently taken a meal, are presumptive evidences of gastric or duodenal contusion or rupture, but the added symptoms of the passage of blood per rectum and the signs of extending peritonitis with its accompanying symptoms may mask the true condition; the diagnosis of ruptured intestine is then in order.

Suffice it to say that gastric rupture is far less common than is intestinal rupture and the surgeon displaying foresight and skill will usually resort to a midline incision, varying its length and extent by his findings at operation. If muscular rigidity and tenderness is over an intestinal area, with the other symptoms pointing to a rupture of a viscus, intestinal perforation may be considered as a probability.

The finding of even small sites of trauma may markedly aid in the diagnosis. Signs of extreme shock, later symptoms of tympanites, and the progressive and obliterated liver dulness, together with emphysema of the abdominal wall, will always help in forming a diagnosis of a rupture of some viscus of the alimentary tract.

Injury of Pancreas

Pancreatic injury is an extremely rare condition. In most instances it is accompanied by a very severe injury to the stomach, spleen, liver, kidney or intestine. Opie states that there are cases on record in which the injury was almost wholly limited to the gland. Sudden pressure or compression, together with sharp blows over the epigastric region, especially in children, usually bring about the condition.

External evidence of injury may be absent. The symptoms of severe epigastric pain, radiating over the entire abdomen, accompanied by nausea and vomiting and sudden and extreme shock, together with severe epigastric tenderness and rigidity, with possibly the signs of free fluid in the lesser peritoneal cavity, comprise the symptom-complex. It is noted that the shock may be delayed for some hours.

Injury to Liver

Injuries to the liver are usually caused by crushing blows, stab and gunshot wounds, exerted especially over the right hypochondrium.

A contused liver may often be diagnosed from the history of the accident,

from soreness and pain upon percussion, pressure and deep breathing; at times, a fine crepitation may be noted over the liver region.

A rupture of the liver may give rise almost immediately to the symptom-complex of acute shock; at other times there may be a marked retardation in the acuteness of the symptoms, true signs of internal hemorrhage not appearing for hours after the accident. On the whole, the symptom-complex of a ruptured liver embraces the following signs and symptoms, namely, those of a severe crushing blow, stab or gunshot wound exerted most especially over the right hypochondrium; local signs of a wound or a severely contused right lower thorax or abdomen (especially right hypochondrium and epigastrium); perhaps bony crepitus of the ribs, low down on the right side; the symptoms of shock plus the signs of internal hemorrhage; a gradual increase in the liver dulness with marked pain on palpation and superficial and deep pressure; difficulty in breathing; a localized muscle spasm over the liver region; a decrease in the mobility of the costal arch; and a gradual increase of dulness in the right flank with, perhaps, an accumulation of fluid in the pelvis.

It must be remembered, however, as stated above, that practically all of the symptoms may be retarded in their appearance. Jaundice is usually a late symptom.

Injury of Gall-Bladder

The above condition is rare; indeed, a ruptured gall-bladder more frequently occurs from a pathologic condition than from trauma.

Wounds of the gall-bladder are usually distinguished from wounds of the liver by the rapid and steady appearance of the flow of bile in the former condition. In the latter, bile may not appear from the wound for days.

Traumatic rupture of the gall-bladder occurs in the same manner as does liver rupture and gives rise to the same train of symptoms, including the severe and acute signs of internal hemorrhage. Acute pain, tenderness and muscular rigidity of the right hypochondrium and right lumbar region (at times); excessive vomiting with more or less symptoms of shock, accompanied by a gradual appearance of peritonitis symptoms together with the presence of jaundice, are the symptoms most frequently present. If the common bile-duct alone is affected the stools are clay colored.

Injury of Spleen

Injuries of the spleen are of fairly common occurrence and follow wounds and crushing injuries of the left thorax and abdomen. A contused spleen may give rise to symptoms of pain, tenderness, and muscular rigidity over the splenic region, minus symptoms of great shock. In the general run of cases, the history of the accident, with local signs of superficial trauma over the left thoracic region or left hypochondrium or both; the rapid collapse of the patient from signs of internal hemorrhage; the muscular rigidity and tenderness over the left upper abdominal quadrant; the diffuse abdominal pain, most prominent in the left hypochondrium and the increase of dulness, downward and forward over the splenic region, rarely movable on the shifting of position to the right, are symptoms which will aid greatly in the forming of a diagnosis of a ruptured spleen.

At times, the signs of internal hemorrhage may be absent for hours. Ballance's sign may be present.

Ballance's Sign.—When this sign is present it is pathognomonic of splenic rupture. When there is free blood in the peritoneal cavity both flanks are dull on percussion. By a change in position the right flank alone becomes resonant because blood-clots from the ruptured spleen, adherent to the left side, give a persistent dullness. This sign may be absent even though the spleen is injured.

A contused spleen may give rise to symptoms of pain, tenderness, and muscular rigidity over the splenic region, without the symptoms of great shock.

Injury to Urinary Tract

Kidney.—Injuries of the kidney are fairly frequent, and should always be considered as possibilities when a person meets with an abdominal, loin or low thoracic accident. Males are more frequently affected than are females. The causative factors are: Falls from heights and striking upon some sharp object; blows upon the loin or front of abdomen; occasionally undue muscular exertions; and stab or gunshot wounds. The most frequent etiologic factor is, however, blunt violence. The right kidney is more frequently involved than is the left.

Clinically, injuries of the kidney may be considered as being divided into two great groups, namely, (1) contusion and (2) rupture, including wounds.

In certain cases of *contusions* of the kidney there may be but few symptoms, while in others, the signs may be so positive and the indications for surgical procedure so prominent that, at times, the case may be looked upon as one of definite rupture. Hence it is that the surgeon must use his utmost care in the interpretation of the symptoms and not expose a patient, already in a shocked condition, to the further trauma of surgery.

Ordinarily, a contused kidney will give local loin signs rather than those referred to the abdomen. This will not be true at first, however, provided the blow received by the patient has included the solar plexus, in which case the primary symptoms are those of extreme shock.

As the symptoms of the nervous shock subside, and in the case of a contused kidney, the local signs will be those of perhaps ecchymosis and edema over the area injured, of pain and tenderness over the kidney region, possibly a perinephritic swelling and the appearance of variable amounts of blood in the urine. Pain may be referred along the course of the ureter and to and involving the testicle; muscular rigidity over the costovertebral angle is noteworthy.

Rupture of the kidney, due to direct or indirect violence, may give the symptom-complex of a contused kidney and it is quite probable that lacerations and minor ruptures of the kidney often improve spontaneously and do not demand surgery. On the other hand, the severity of the symptoms may be so pronounced as to necessitate exploration.

In this condition, it must be borne in mind that the symptoms due to a definite rupture of the kidney may be, for the most part, referred to the abdomen and resemble, in most respects, the rupture of an intraperitoneal viscus. But added to these signs are always present certain features which will aid in the diagnosis. In addition, therefore, to abdominal muscular rigidity and tender-

ness, signs of partial or complete collapse and perhaps nausea and vomiting are present; appearance of blood in the urine, usually very pronounced, of spasm of the costovertebral angle, of perhaps a loin or abdominal mass, increasing in size, points to severe kidney injury.

Occlusion of the ureter by a blood-clot may forestall the appearance of blood in the urine, which is the most valuable sign of renal injury. However, the symptoms usually warrant cystoscopy, and this procedure, as a rule, reveals the condition.

Ureter.—Because of their anatomic location, the ureters are rarely injured by external violence. It is even exceptional for a gunshot or other penetrating wound to involve these structures. Accidents during operations are the most frequent causes of ureteral injury.

The signs of contusion of the ureter are usually overshadowed by the traumatic signs referable to adjacent structures. The same is often true regarding rupture of the ureter, as other viscera are usually injured at the same time. In fact, rupture or tearing can only be diagnosed clinically by escape of urine from a penetrating wound below the level of the kidney. Other signs, such as hematuria, do not differ from those of renal injury, while the local signs, in the presence of a non-penetrating injury, are in no wise diagnostic. Cystoscopy and ureteral catheterization are important aids.

Bladder.—The urinary bladder may be injured by penetrating or non-penetrating wounds, as well as by falls upon the buttocks, fractures of the pelvic bones and internal or spontaneous perforations. The latter occur especially in comatose or delirious patients or as a result of overdistention following urinary obstruction. Pathologic rupture may also occur in tuberculosis and malignancy. Sounds, catheters or other urethral instruments may produce perforation from within.

Contusion of the bladder may be inferred when there has been trauma to the abdominal wall, particularly over the symphysis pubis, followed by localized pain and tenderness and difficulty or distress in voiding or by anatomic conditions of the bladder wall causing overdistention. Such symptoms are temporary. A small or large amount of blood may appear in the urine from an injury of a vessel of the mucosa, but this is exceptional.

The symptoms of rupture of the urinary bladder vary with the site of perforation—that is, whether the rupture is intraperitoneal or extraperitoneal. The initial symptoms, however, are the same in both instances. The affection is more frequent in males and usually occurs when the bladder is full.

A penetrating abdominal or perineal wound is highly suggestive, of course, whether or not urine escapes therefrom. A non-penetrating wound frequently gives no external signs of trauma. There is some initial shock, accompanied by abdominal or deep pelvic pain, and frequently a strong desire to urinate. Upon palpation, there are tenderness and muscular rigidity above the pubis. Little or no urine is obtained by catheterization. If a measured quantity of sterile solution is injected into the bladder, only a portion of it, or none whatever, is returned.

The site of perforation determines the future course. When extraperitoneal, the surrounding tissues become infiltrated with urine according to the disposition of the fascial planes. The infiltration involves especially the perineum, buttocks, scrotum or other external genitalia, and often the anterior abdominal wall.

Abscesses may develop in any of these situations; in fact, an abscess of the suprapubic region or of the space of Retzius may be the presenting symptoms in cases which have not had immediate attention. A general peritonitis may follow.

A final picture is one of sepsis, or of ascending renal infection.

Tearing of Mesentery

This produces signs and symptoms of intra-abdominal hemorrhage often with the presence of a tumor mass about the site of mesenteric injury.

Contusion or Rupture of Diaphragm

The diaphragm may be ruptured or torn by penetrating or non-penetrating wounds of the lower thorax and abdomen. In the case of a penetrating wound, injury of the diaphragm may be suspected from the location and characteristics of the wound, or a bullet or shell fragment may lodge in the diaphragm and be localized by fluoroscopy. In such injuries the tear is usually small and produces no special symptomatology.

Subcutaneous rupture, induced by crushing injuries, is usually accompanied by severe shock, cyanosis and dyspnea. When the traumatic opening allows prolapse of the stomach, the intestines, or other abdominal viscera into the thoracic cavity, these symptoms are greatly exaggerated and the physical evidence of displacement of the heart and compression of the lungs is usually present.

The lower portion of the chest is tympanitic because of the position of the stomach, gut or both, and gurgling sounds may be heard over this area. In some cases the protrusion of viscera is more gradual and less extensive, so that symptoms of intestinal obstruction succeed the initial period of shock.

Rupture of the Abdominal Aorta

Rupture of the abdominal aorta or its branches is usually rapidly fatal, unless immediate compression has been made. The signs and symptoms are those of internal hemorrhage. Unilateral absence of the femoral pulse indicates rupture of the corresponding iliac artery. Either blunt violence, such as crushing trauma, or penetrating gunshot or stab wounds may produce rupture of intra-abdominal vessels.

Fractured Pelvis

(See also chapter on "Fractures and Dislocations.")

Fractured pelvis results from falls, severe blows or crushes. It may complicate injuries of intra-abdominal viscera, especially the bladder. The patient experiences pain upon motion or when in certain postures, and usually refers this pain to the site of fracture, although occasionally the lower abdomen, having borne the greatest trauma, is the location of the most severe pain.

Tenderness is elicited by pressure over the point of fracture and manual compression of the iliac wings toward the midline causes pain. There is rarely any deformity, except when the acetabulum is fractured; a complete or partial hip

dislocation produces alterations in the regional contour and in the position and length of the limb. Because of spasm of the adjacent musculature and the localized tenderness, fractures of the os pubis frequently simulate an intra-abdominal injury, particularly a ruptured bladder. Rupture of the bladder is a common complication of this condition.

Radiographic examination is the deciding factor.

CHAPTER XVI

THE ABDOMINAL WALL, UMBILICUS AND HERNIA

AFFECTIONS OF THE ABDOMINAL WALL

Injuries	{ See section on "Abdominal Injury." { See section on "Hernia."	
Inflammatory conditions	{ superficial { furuncle { carbuncle { cellulitis { deep (within sheath of recti) { retromuscular { retroperitoneal tissues { space of Retzius { perinephritic tissues { extraperitoneal subphrenic tissues	
Granulomata	{ tuberculosis { actinomycosis	
Cyst	{ sebaceous { echinococcus	
Hematomata		
Tumors	{ benign { lipomata { fibromata (durum-molle) { papillomata { nevi { desmoid { malignant { sarcomata { round { spindle { melanotic { carcinoma { epithelioma { secondary to { disease of viscera	
Hernia		

Injuries

(See sections on "Abdominal Injury" and "Hernia.")

Inflammatory Conditions

Inflammatory conditions of the abdominal wall may be divided into superficial, deep and retromuscular.

Superficial inflammations are subdivided into furuncles, carbuncles and cellulitis and do not differ from like conditions found elsewhere in the body. Abdominal

wall suppuration may appear shortly after, or months following, abdominal operations and may be due to wound infection, following the use of infected silk or chromic catgut sutures, or to one of the many factors considered in producing an infected wound or a deep-seated inflammatory process.

Redness, brawniness of the skin, fever, pain and tenderness on pressure, inguinal gland enlargement and usually a hard, boardlike indurated feel of the affected area with seldom definite signs of fluctuation, constitute the symptom-complex of *cellulitis*. It is noteworthy, however, that, at times, small areas of fluctuation may be detected.

Deep.—The deeply situated inflammatory conditions of the abdominal wall possess certain characteristics, due to the arrangement and distribution of the fascial planes. Thus the inflammatory lesions beneath the anterior sheath of the rectus muscle cannot spread laterally, and present themselves in the neighborhood about the umbilicus, where they may appear as semifluctuant, indurated areas; they may perforate in this location. In this condition the swelling is most pronounced with the patient in the recumbent position.

Retromuscular.—The deeply infected processes, situated between the peritoneum and the musculature of the abdominal wall, invariably spread downward and appear in the prevesical space.

From literary sources, the classification of the etiology of this condition has been obtained and is as follows:

Retroperitoneal Connective Tissue of the Iliac Fossæ

Osteomyelitis or tuberculosis of pelvic bones

Deep inguinal or deep iliac adenitis

Disease of spine or rib

Disease of a viscus

Space of Retzius

Inflammation of bladder, prostate or seminal vesicles

Tuberculosis of bladder, prostate or seminal vesicles

Inflammation or tuberculosis of female pelvic viscera

Perinephritic Region

Inflammation of the kidney or perirenal inflammation

Tuberculosis of kidney

Extrapерitoneal Subphrenic Tissue

Appendix or hepatic abscess

Perigastric abscess

Abscess in the space of Retzius usually gives rise to a definite symptom-complex, comprising the following symptoms: An oval, circumscribed, indurated, dulness, tender and painful with signs of inflammation; situated over the bladder region and not relieved when the patient empties the bladder, persisting, as it were, in its entirety and becoming more prominent when the patient lies down. The tumor may be distinctly felt through the rectum or vagina. At times, the abscess is evacuated by rupturing into the bladder or intestines.

Constitutional symptoms, such as chills and fever, malaise and drowsiness, often accompany this condition. Such symptoms may, however, be entirely absent.

Granulomata

Tuberculosis of the abdominal wall is invariably secondary to tuberculosis of the peritoneum, intestines, appendix and cecum, inguinal lymph-nodes, bladder, or seminal vesicles and prostate; as a primary condition it is practically unknown. An invasion of the abdominal wall by the tubercle bacillus is primarily characterized by a small, indurated, subcutaneous area, painless to the touch and showing few signs of inflammation.

As the condition progresses, the skin becomes of a red-purple hue, blending with the surrounding tissue, and within a short time a small sinus forms, exuding a turbid fluid. The superficial tissue gradually breaks down, with, at times, the formation of multiple sinuses. Ulceration occurs, the edges of the ulcer being covered with soft, red-yellow granulations. As the process advances, a dirty caseous exudate appears.

Actinomycosis is a chronic inflammatory condition and, in the vast majority of cases, is secondary to actinomycosis of the intestinal tract, especially that of the appendix and cecum. The disease first appears as a small, painless, indurated, non-circumscribed area, with a very gradual involvement of the skin, which becomes reddened and finally perforates, with the formation of a sinus. The latter is surrounded by soft, dirty yellow granulation "clips," and the exudate often assumes a vivid yellowness in which, at times, is found the actinomycotic granules. Secondary infection often causes the sluggish process to assume a more active grade of inflammation.

Cysts

The sebaceous and echinococcus cysts are found in this locality; the former frequently, the latter very rarely.

A sebaceous cyst is similar in all respects to those found elsewhere in the body. For description see chapter on "Tumors."

The echinococcus cyst is of such rarity in this location that its occurrence is looked upon as of extreme pathologic interest. It is usually benign and appears either within the muscles or properitoneally. A clinical diagnosis cannot be made, though the history of an echinococcic infection of the patient elsewhere in the body may give a possible clue.

Characteristically they appear as any ordinary type of cyst.

Hernia

(See section on "Hernia.")

Hematomata

Hematomata of the abdominal wall are of frequent occurrence and usually follow traumatism, though occasionally they may form following a rupture of an abdominal wall varicosity. At times, they are so hard, and so utterly escape the palpating hand when the abdominal wall is under tension, that they may be

confused with a desmoid tumor. Usually, however, a superficial ecchymosis and the history of an injury will clear up the diagnosis.

Tumors

Benign.—The *lipomata*, *fibromata*, *papillomata* and *nevi* resemble, in all respects, tumors of this type found elsewhere in the body. See chapter on "Tumors."

The *desmoid* is essentially a fibroma of the abdominal wall, possessing certain clinical features distinguishing it from the usual fibromatous tumor. It usually appears first as a small, oval, hard, smooth and regular painless mass, most frequently situated in the midline of the abdomen, most often found in women who have borne children, and with a tendency toward slow but steady growth until, at times, it reaches a considerable size.

The skin is usually of normal consistency and hue over the mass, though enlarged veins may gradually present. From an intraperitoneal growth, it may be differentiated by *its disappearance and non-palpability when the abdomen is made tense*.

The tumor is not truly malignant though there is a marked tendency toward local recurrence. Occasionally desmoids undergo sarcomatous changes.

Vascularity is one of the features of the tumor and a hemorrhage within the mass will often cause a formerly hard growth to become one of a fair degree of softness. As the tumor progresses pain may become an important element.

Malignant.—Malignant tumors appear in the form of sarcoma and carcinoma.

Sarcomata of the abdominal wall generally represent a sarcomatous change of a fibroma, desmoid or pigmented nevus, though they may start primarily as a malignant tumor from the connective tissue of the abdominal wall.

Intraperitoneal and bony sarcomata may, however, give rise to abdominal wall implantations or metastases. They appear as round, spindle and melanotic. Their course and extension is very rapid and the prognosis very unfavorable.

Primary carcinoma of the abdominal wall is extremely rare, arising as an epithelioma and bearing the usual characteristics of such a growth. While theoretically an epithelioma may develop anywhere in the cutaneous surface, the majority of abdominal wall epitheliomata arise at the umbilicus.

Carcinoma is usually secondary to carcinoma of the abdominal contents, especially of the stomach and cecum. It is very likely to appear in the form of a subcutaneous nodule at or near the umbilicus. Such an occurrence is highly significant in the presence of a palpable intra-abdominal mass, or in a patient of middle age with indefinite gastro-intestinal symptoms. Secondary carcinomata do not exhibit ulceration until relatively late.

AFFECTIONS OF THE UMBILICUS

Inflammatory conditions	{	acute
		chronic
		abscess
		erysipelas
		gangrene
		noma

Concretions	
Fistulæ	
Hernia	
Gumma	
Cysts	{ dermoid sebaceous of congenital structures
Tumors	{ benign { papillomata lipoma myxoma fibroma angioma malignant { carcinoma sarcoma

Inflammatory Conditions

Acute inflammation of the umbilicus occurs particularly in the newborn and may be superimposed upon parasitic or other cutaneous affections. The condition is characterized by the usual signs of inflammation. When the cord has not yet separated, there is a purulent discharge accompanied by sloughing of the cord with granulation tissue at the base. In infants, the umbilicus may be the site of entrance of organisms in pyemia, and in many other pyogenic conditions.

Chronic inflammation of the umbilicus accompanies uncleanness and various skin diseases, and exhibits a thickened, irritated surface or softening and maceration of the skin, with the discharge of a foul smelling substance composed partly of dirt and partly of secretions.

Abscess of the umbilicus represents a further stage of an acute inflammation. It is evidenced by brawniness and tenderness followed by localized fluctuation.

Erysipelas of the umbilical cord or of the umbilicus after the cord has separated, should be suspected whenever a spreading cellulitis in that region is observed. The usual features of the disease are present.

Gangrene is a rare complication of acute inflammations and is more common when an arteritis or phlebitis of the umbilical vessels is present.

Noma may also occur at the umbilicus, usually following one of the acute infectious diseases. The destruction of tissue in the gangrenous process may be extensive, involving, in some cases, the entire thickness of the abdominal wall. The constitutional symptoms vary.

Concretions

Concretions sometimes form at the umbilicus as the result of chronic inflammation. They are found embedded in dirt and purulent material and often produce ulceration of the skin.

Umbilical Fistulæ

Umbilical fistulæ are of various types, the nature of which is to be recognized by the character of the escaping material, the history of the patient and the coexisting physical findings. Congenital fistulæ include a patent urachus and a patent omphalomesenteric duct. Acquired fistulæ may connect the umbilicus with any of the intra-abdominal organs or with the peritoneal cavity. Urine, bile, gastric juice or feces, pus and tuberculous material or ascitic fluid may escape, furnishing a clue to the underlying source of the particular fistula. A fistula should not be confused with the granulomatous condition of the cord which sometimes exists in infants and which gives rise to a moderate discharge.

Hernia

Hernia of the umbilicus is not uncommon and is either congenital or acquired. It appears as a protrusion of the umbilicus, usually of small size in the child, but occasionally very large in the adult. This mass increases upon coughing or standing, and can be reduced. An impulse on coughing may be felt. In the larger varieties an irregular, lobulated, soft mass composed of omentum may be felt beneath the skin and gurgling sounds of intestinal origin may be produced by manipulation. The separation of the tissues of the abdominal wall at the umbilicus is readily determined by palpation. Strangulation is a complication of umbilical hernia.

Gumma

Gumma may be present at the umbilicus. It is a chronic condition in which a slow-growing, regular or irregular, elastic mass, usually of small size and covered by reddened and thickened skin, develops. In the later stages, ulceration may occur. Its course, the personal history, other signs of the disease and the Wassermann reaction contribute to the diagnosis.

Cysts

Various cysts occur at the umbilicus. These include dermoid, sebaceous cysts and those of congenital origin. The *dermoid* cyst may attain a large size; is firm, smooth or irregular and may show areas of fluctuation.

Sebaceous cysts have the usual features and are subject to infection. A *congenital* cyst may form within the urachus, its fluctuant nature and situation between the umbilicus and symphysis pubis are diagnostic. A cyst of the vitello-intestinal duct may also arise.

Tumors

Benign.—*Papillomata* are fairly common. They are single or multiple, pedunculated tumors usually of small size and are observed arising from the skin at the umbilicus. Their summits are pale or pinkish and cauliflowerlike, and they may become ulcerated or give rise to a thin discharge because of local irritation.

Lipoma of the umbilicus is infrequent. It is a soft, lobulated, subcutaneous tumor, freely movable and either round or pedunculated. The occurrence of the

myxoma and *fibroma* is also unusual, the two having the usual characteristics of benign tumors and differing from each other only in consistency. An *angioma*, if superficial, is distinguished by its reddish or purplish color.

Malignant.—Malignant tumors include carcinoma and sarcoma. They may be either primary or secondary; a malignant tumor of the umbilicus may be the sole evidence of such a disease of an underlying viscus, or establishes the malignant nature of an intra-abdominal mass.

Primary carcinoma occurs in the form of an epithelioma which arises spontaneously or upon an irritated papilloma. There develops gradually an elevated area of the skin which becomes infiltrated and is prone to ulcerate. The age of the patient, the invasion of adjacent skin or the indurated border of the ulceration, if such is present, are sufficient for diagnosis. Inguinal lymph-node involvement is relatively late.

Sarcoma of the umbilicus occurs at a younger age than carcinoma. It appears as a nodular or smooth tumor covered by a normal or bluish-red skin. The common type is fibrosarcoma and the rate of growth is moderately rapid. Subsequently, adherence to the skin and the surrounding tissue takes place and there may be ulceration.

Secondary malignant tumors present as firm subcutaneous nodules in the early stages. Progression in size, attachment to surrounding structures, and often ulceration of the skin ensue. The primary involvement is found especially in the intestine, stomach, ovaries or uterus.

HERNIA

Inguinal hernia	{	complete	{	scrotal			
				labial			
		incomplete					
		oblique or indirect inguinal	{	acquired			
				congenital	{	vaginal	
					funicular		
direct	{	supravesical	{	internal			
				external			
interstitial	{	properitoneal (intraparietal)					
		subaponeurotic (interparietal)					
		subcutaneous (extraparietal)					
Femoral hernia	{	complete					
		incomplete					
		diverticulum through the cribriform fascia (Hesselbach, 1816)					
		diverticulum through the superficial fascia (Cooper, 1807)					
		properitoneal diverticulum (Tessier, 1834)					
		pectineal (Cloquet, 1814)					
		retrovascularis					
		external to the femoral vessels (Partridge, 1846)					
		through Gimbernat's ligament (Laugier, 1833)					

Umbilical hernia { congenital
infantile
adult

Ventral hernia

Lumbar

Incisional

Obturator

Epigastric

Diaphragmatic

Perineal

Pudendal

Vaginal

Sciatic

Cerebri

Internal hernia

Hernia of the lung

Muscular hernia

Hernia of the testis

Hernia of the large intestine

Clinical varieties { reducible
irreducible
inflamed
obstructed
incarcerated
strangulated

Anatomic varieties { enterocele
epiplocele
entero-epiplocele
any intra-abdominal organ may present in hernia sac

Etiology

Age.—Infantile or early adult life; any.

Sex.—Men and boys more often.

Preformed or Congenital Sac

Hereditary Tendency.—Questionable.

Weakness of the Abdominal Wall

- After abdominal operation
- After injury to motor nerve in inguinal region
- After debilitating illness
 - Atrophic changes
- Pregnancy
- Relaxation of the abdominal parietes

Increased Strain Due to Abdominal Contents

- Gradual deposition of fat in omentum and mesentery
- Ascites
- Intra-abdominal tumors
- Pregnancy

Repeated Strain on the Abdominal Wall

- Coughing
- Straining at stool
- Difficult micturition
 - Congenital phimosis
- Lifting
- Parturition
- Sneezing

Late Descent of Testicle**Congenital Phimosis****Congenital Apertures, Linea Alba, Linea Semilunaris****Trauma****Inguinal Hernia****Complete.**—*Symptoms*

- Swelling at upper part of one side of scrotum
- Swelling passes up into groin on outer side of pubic spine
- Usually readily reduced
- Reappears on coughing; impulse on cough
- External abdominal ring usually will admit at least one finger
- Internal ring cannot be felt
- If of long standing both rings may be opposite each other

Incomplete.—*Symptoms*

- Swelling along the course of inguinal canal

Oblique or Indirect Inguinal Hernia.—*Etiology*

- Incomplete obliteration of the funicular process
- Internal oblique muscle may not always take origin from Poupart's ligament
- Hernia usually lies in front of spermatic cord

Symptoms

- May be complete or incomplete
- Swelling along the course of inguinal canal
- Distinct impulse felt on coughing
- Can be made to disappear by gentle taxis or when patient lies down
- External abdominal ring usually will admit at least one finger
- Internal ring cannot be felt
- If of long standing, both rings may be opposite each other

More common on the right side

The longer the duration, the less oblique becomes the passage through the abdominal wall

If in scrotum, hernia is not attached to testis

If in female, hernia lies in labium or canal of Nuck

Emerges lateral to deep epigastric artery

ACQUIRED INGUINAL HERNIA.—*Etiology*

Due to non-closure of the uppermost part of the funicular process

Chronic strain; acute effort

Symptoms

Sac of peritoneum protrudes from within abdomen

Gradually increases in size

Sac extends as far as the head of the epididymis

Internal ring pulled downward and medially

CONGENITAL INGUINAL HERNIA.—*Etiology*

Non-closure of funicular process

Phimosis

Heavy work

Symptoms

May not appear until puberty

Usually on the right side

Becomes complete at once

Protruded viscera may come in contact with testis (vaginal)

May come in contact with epididymis (funicular)

INFANTILE OR ENCYSTED HERNIA

Direct Inguinal Hernia.—*Etiology*

Same as hernia in general

More common in men than in women

Seldom is complete

Never is congenital

Smaller than oblique

Rare before forty years of age

Often contains urinary bladder or bladder diverticulum

Symptoms

Same as incomplete

Frequently occurs on both sides

Spherical in shape

Tends to spread toward median line, rather than toward scrotum

Cord lies to outer side or behind hernia

Seldom becomes strangulated

Emerges medial to deep epigastric artery

Emerges through Hesselbach's triangle

SUPRAVESICAL.—*Internal*

Hernia occupies a properitoneal position near the bladder

External

May lie between the conjoined tendon and external oblique aponeurosis

May lie in subcutaneous tissue superficial to external oblique aponeurosis

Interstitial.—INTRAPARIETAL

Hernia is between transversalis fascia and the peritoneum

Sac may extend between symphysis and bladder and toward iliac fossa

Symptoms

No swelling—recognized only at operation

May cause continuation of symptoms of strangulation

INTERPARIETAL

Hernia situated between internal and external oblique muscles

Etiology

Associated with late descent of the testis

Existence of a more or less complete septum at the level of the external abdominal ring due to adhesions or adherent mass of omentum

Symptoms

Swelling in the region of the inguinal canal

Swelling gradually spreads upward and outward

EXTRAPARIETAL.—Etiology

Associated with late descent of the testis

Contracted state of the scrotum

Always congenital

Hernia escapes through the external abdominal ring and travels parallel with Poupart's ligament

Femoral Hernia

Complete.—When hernia passes through the entire length of the canal and presents beneath the skin of the groin

Incomplete.—When hernia remains in the femoral canal

Etiology

General causes of hernia

More common in women, especially those who have borne children

Follows operation for inguinal hernia, due to the pulling up of Poupart's ligament

Symptoms

Swelling is rounded

Impulse on coughing

More or less reducible

Forms on inner side of thigh

Neck of sac lies on lateral side of and below pubic spine and medial to the femoral vessels

Hernia is usually small and more often contains omentum than a coil of intestine

Strangulation occurs relatively more often than in inguinal hernia

Hernia rarely gives rise to subjective symptoms until it becomes inflamed or strangulated

Pain at site of hernia often referred to the umbilicus

Dragging sensation in groin

If hernia contains a loop of the intestine there may be a tympanitic note obtained over it

May extend over Poupart's ligament and appear like an inguinal hernia

Rarer forms of femoral hernia have no definite etiology or symptomatology.

Umbilical Hernia

Congenital.—EMBRYONIC.—*Etiology*

Failure of development of the abdominal wall (eventration)

FETAL.—*Etiology*

Development after the third month of intra-uterine life

Infantile.—*Etiology*

May develop any time after the cicatrization of the navel

Seldom appears after the second year

Chronic constipation

Phimosis

Symptoms

Usually small; sometimes huge size

Presents more often at the side and above the umbilicus rather than directly beneath it

Pressure reduces the hernia easily in absence of adhesions

When child cries or strains the hernia becomes larger and more tense

Palpable defect when reduced

Adult.—*Etiology*

A sequel or a recurrence of the infantile form

More frequent in women

Repeated pregnancies dispose

Rupture of the linea alba

Symptoms

Protrusion usually occurs above the umbilicus

Usually irreducible

May become pendulous

Incarceration frequent, strangulation not unusual

Diastasis of the recti muscles above and below the hernia

Pressure atrophy of the tissues overlying it

Ulceration and perforation of the overlying tissues

Hernia may be lobulated in character

Considerable deposit of fat around it

Impulse on coughing

When abdominal muscles are contracted the tumor becomes erect and tense

Pain on severe exertion

Feeling of weakness and lack of support

Digestive disturbance and constipation

Pain from adhesions and local peritonitis

If strangulated or incarcerated, visible peristalsis

Gurgling often pronounced

Ventral Hernia

Etiology

- Yielding scars of operation wounds
- Diastasis of recti muscles
- Small fatty hernia of linea alba above navel dragging on the peritoneum
- Injury resulting in the rupture of the abdominal muscles

Symptoms

- Pain in the abdomen
- Occasional vomiting, and intestinal colic worse upon movement of body
- Constipation, sense of weakness
- Protrusion

Lumbar Hernia

Hernia occurs between the external oblique and latissimus dorsi just above the iliac crest and below the twelfth rib (Petit's triangle), or occasionally through a vascular foramen of lumbar aponeurosis.

Etiology

- Spontaneous
- Trauma—as a crushing injury
- Subsequent to kidney operations

Symptoms

- Reducible
- Sensation of weakness at point of hernia
- Bulging during straining efforts
- Tumor mass round or oval
- Distinct impulse when patient coughs
- Disappears spontaneously or by gentle pressure

Incisional Hernia

Etiology

- Develops in cicatrix of an operative incision
- Wounds which have been drained, or have been infected
- Faulty closure
- Hemorrhage

Symptoms

- Hernia may be of any size
- Abdominal contents lie in direct contact with skin and fascia
- Strangulation rare and incarceration only when aperture is small; adhesions usual
- Pain in abdomen
- Vomiting
- Colicky pains with every movement of body
- Gurgling often pronounced
- Rarely, visible peristalsis

Obturator Hernia**Etiology**

- Most frequent in elderly women
- Slow formation

Symptoms

- Hernia protrudes through the obturator foramen in Scarpa's triangle beneath the pectineus muscle
- Often bilateral
- Usually not recognizable until strangulation occurs
- Intestinal obstruction
- Pain in region of obturator foramen
- Radiation of pain in distribution of obturator nerve
- Tender swelling beneath pectineus muscle
- Sac may be palpated on inner surface of obturator foramen through the vagina or rectum

Epigastric Hernia**Etiology**

- More frequent in men
- Severe strain on abdominal musculature

Symptoms

- Pain
- Small mass is irreducible or reducible
- Simulates peritonitis

Diaphragmatic Hernia**Etiology**

- Congenital defect in diaphragm
- Defect may be present but hernia does not appear until adult life
- Most cases occur in fetus or stillborn infants
- Traumatic
 - Sudden blows on abdomen
 - Strain on abdominal musculature
 - Usually on left side
- Crushing injury
- After stab and gunshot wounds

Symptoms

- Cyanosis
- Dyspnea
- Left thorax does not expand, as does right
- Dextracardia
- Indigestion and distress after meals
- Sudden cardiac failure
- Acute distention of herniated stomach
- Strangulation frequent

Tympany in lower left chest
Breath sounds distant or feeble
Vocal fremitus lost
Diaphragm does not descend on deep inspiration
Fluoroscopy and x-rays

Perineal Hernia

Etiology

Congenital anomalies
More frequent in women than in men
Occurs between the rectum and prostate
Often associated with prolapse of the rectum
In the female, the hernia may protrude from the pelvis on either side of the broad ligament or in the posterior vaginal wall

Pudendal Hernia

Etiology

Congenital anomaly
Hernia leaves the pelvis in front of broad ligament and enters labia

Vaginal Hernia

Etiology

Congenital anomaly
Associated with procidentia uteri
Hernia protrudes in the posterior vaginal wall

Sciatic Hernia

Etiology

Congenital
Traction of a gluteal lipoma, myxoma or other tumor

Symptoms

Sac protrudes either through the greater or lesser sacrosciatic foramen
Tumor mass along the perineal border of gluteus maximus
Strangulation common
Pain over gluteal region; sciatica
Impulse on coughing
Gurgling sounds when reduced

Hernia Cerebri

Etiology

Subsequent to decompressions in subtemporal region
Increased intracranial pressure
Compound depressed or punctured fracture with infection of the underlying brain substance
Mastoid operations
Congenital

Symptoms

Tumor mass consists of brain substance, edematous granulation tissue and sometimes blood-clots
 Mass is soft and dusky in color
 Pulsating tumor, synchronous with pulse
 Tumor mass increases in size rapidly
 Mental condition unimpaired at first
 Coma
 Death
 Congenital forms rounded or pedunculated; mostly occipital
 Partly reducible—causes vomiting and rapid pulse
 Becomes tense when crying, straining; may be translucent

Internal Hernia**Etiology**

May occur in duodenojejunal fossa, pericecal fossa, or in mesosigmoid fossa
 Hernia may protrude through the foramen of Winslow or through a congenital or acquired opening in mesentery of the small intestine

Symptoms

Usually gradual in onset
 Symptoms of chronic obstruction
 Tumor mass may be palpable in the abdomen
 Pain in the region involved
 Acute obstruction often supervenes

Hernia of the Lung**Congenital.—*Etiology***

Defect in the chest wall
 May develop at root of neck

Acquired.—*Etiology*

May occur months or years after injury to thorax
 Weakening of chest wall at site of injury
 Laceration of intercostal muscles and pleura

Symptoms

Rounded swelling is spongelike in consistency
 Crepitation on pressure; tactile fremitus
 Always reducible
 Loud vesicular murmur heard over tumor mass
 Increases in size during forced expiration
 May disappear on inspiration
 Impulse on coughing

Muscular Hernia**Etiology**

External injury (contusion)
 Violent muscular contraction
 Penetrating wounds of fascia

Symptoms

Tumor mass of bulging muscle when relaxed

Protrusion disappears on passive elongation or active contraction of muscle

Aperture in sheath is palpable

Hernia of the Testis**Etiology**

Septic penetrating wounds of testis

Acute suppurative orchitis

Chronic abscess of testis

Gumma

Symptoms

Mass of granulating tissue projecting through opening in scrotum

Mushroom-like, in shape

Marked discharge of pus

Hernia of Large Intestine

Gliding hernia—a portion of bowel with no mesentery comes to lie in a pocket which is not lined with peritoneum.

Described as a “pushing” or “pulling” mechanism and also considered as a sacless hernia.

No special etiology or symptoms found.

Clinical Varieties**Reducible Hernia**

Every hernia is reducible when it first appears

Patient feels a sense of weakness when protrusion later develops

Merest bulging of parts during straining efforts

Small, round or oval tumor later develops

Easily reduced by pressure

Disappears when patient lies down

Tumor mass is less broad at neck of sac than elsewhere

Hernia increases in size when patient stands erect, coughs or strains

Distinct impulse on coughing

Tumor is soft if content of sac is intestine, firm, if omentum

No signs of obstruction

No general disturbance

Irreducible Hernia.—*Etiology.*—Adhesions—intravisceral or extravisceral in type

Symptoms

Usually no impulse on coughing

Constantly tends to become larger

Dragging sensation

Digestive disturbances

Intermittent constipation and diarrhea

Inflamed Hernia.—*Etiology*

Irreducible hernia
Unusual contents, *i.e.*, appendix
Accidental trauma
Unskilled or violent attempts at reduction
Pressure of an ill-fitting truss
Changes in contents of sac
Stasis of fecal and gaseous material

Symptoms

Local pain
Tenderness
Nausea
Vomiting
Hernia gives impulse on coughing
Constipation
Flatus

Incarcerated Hernia.—*Etiology*

Temporarily irreducible hernia
Large hernia
Unskilled attempts at reduction
Twisting of herniated bowel

Symptoms

Local pain and tenderness
May advance to strangulation

Strangulated Hernia.—*Etiology*

Constrictions of sac wall or surrounding structures
Site of constriction usually at neck
Wearing of truss for a long period of time
Torsion of contents of sac
Bowel caught in aperture or pocket of omentum
Irreducible hernia
Sudden increase in abdominal pressure

Symptoms

Patient usually has had hernia for a long time
Localized tenderness over hernial region
Sudden pain at site of hernia
Feeling of increase in size of hernial protrusion
Severe pain may be followed by shock
Constant general abdominal pain becoming progressively worse
Absolute constipation, vomitus may be fecal
Spontaneous cessation of pain
False sense of security
Extreme prostration
Signs of impending death (at times)
Diffuse abdominal pain of acute obstruction often masks local pain
Visible peristalsis (at times)

Anatomic Varieties

Enterocoele (sac contains intestine only).—*Symptoms.*

Tumor is smooth, feels elastic
Gurgling sound when palpated
Resonant on percussion
Impulse well marked
Reduction accompanied by distinct gurgle

Epiplocele (sac contains omentum).—*Symptoms*

Tumor mass is firm
Doughy feel
Irregular in outline
Little or no impulse on coughing
Dull to percussion
Reduction not accompanied by a gurgle

Entero-Epiplocele.—Combination of the above two forms

Symptom	Enlarged Glands (Inflammatory, Malignant)	Aneurysm	Femoral Hernia	Vein Varicosity	Distention of Hip Joint (Tuberculosis)	Osteo-Arthritis of Hip
Age	Any.	Adults.	Any. Usually adults.	Usually adults.	Any. Usually children.	Adults and aged.
Antecedent history	Usually acute infection in lower extremity. May be malignant tumor of genitalia. May follow chancreoid.	Trauma, penetrating wounds. Rarely follows syphilitic arthritis.	Usually in females, who are subjected to hard work or trauma.	Especially in legs of those who stand over long periods. Often after difficult labors or "milk-leg," during or following pregnancy.	History of tuberculosis.	May be a so-called "rheumatic" history.
Onset	Rapid in cases following infection. Gradual if accompanied by malignancy.	If traumatic, sudden. Otherwise slow.	Acute, after a sudden, severe strain. May be gradual in its development.	Gradual.	Gradual.	Gradual.
Pain	If an acute adenitis, painful. Usually none if malignant.	Usually absent.	None or discomfort. If strangulated, acute pain.	None or discomfort.	None.	Present.
Description of swelling	Distinct lobulated mass near saphenous opening. If an infected gland, or glandstender, rather soft or fluctuant, discrete or confluent, depending upon extent of involvement. If cancerous, hard and discrete.	Smooth swelling over femoral artery, expansile pulsation and compressible. "Swish" of blood in artery with each pulsation of heart.	Moderate sized swelling below Poupart's ligament between pubic spine and femoral vessels. On being reduced gurgling sound may be heard and intestinal "gas bubble" may be felt. Impulse seen and felt on coughing.	Soft, reducible swelling at the saphenous opening. Usually small and painless. Appears from below upward, when finger blocks femoral canal. On being compressed, thrill may be heard.	Soft, fluctuating, non-inflammatory swelling, usually to inner side of femoral vessels.	Pain and stiffness of hip, increased after resting. Bony hard swelling of hip. Fixed. Encroachment from hip joint towards femoral region.
Special data ..	If tuberculous, signs of tuberculosis elsewhere.	If syphilitic, positive Wassermann.			Characteristic tuberculous pus when abscess is incised.	Progressive. Pain and lameness become severe.

DIFFERENTIAL DIAGNOSIS OF SWELLINGS IN THE INGUINAL REGION

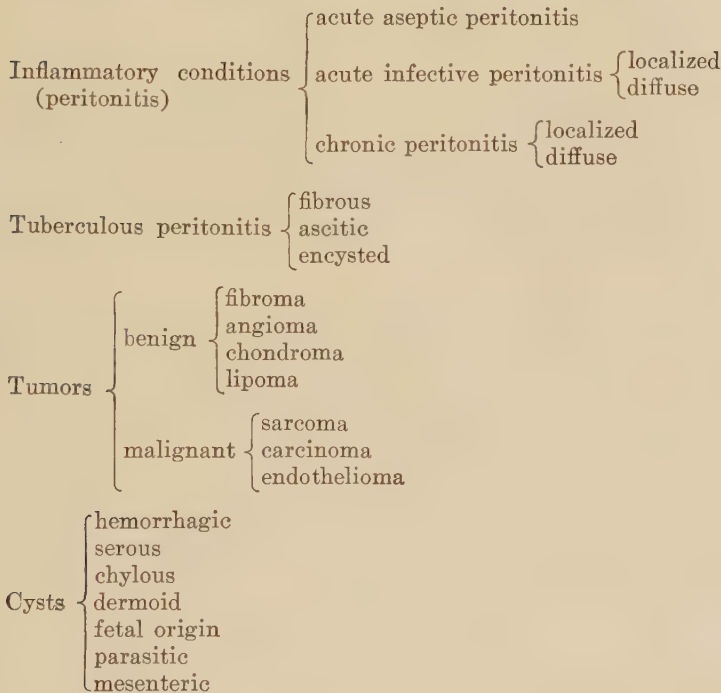
Symptom	Acute Adenitis	Chronic Adenitis*	Aneurysm	Undescended Testicle	Hernia (Inguinal)	Psoas Abscess	Tumors of Cord or Round Ligament
Age	Any.		Adults.	Young children.	Any.	Early childhood.	Any.
History	Local infection. Acute infectious disease. Chan- croid.		Injury. Syphilis.	From birth with absence of testi- cle in scrotum.	Possibly injury or strain.	May appear in course of tuber- culosis of spine.	May or may not be present from birth.
Onset	Acute.		Gradual or acute.	Gradual.	Usually gradual. May be acute.	Usually gradual. May be acute.	Very gradual.
Pain	Present.		Usually discomfort.	Not present, unless it is twisted or secondarily in- volved.	Discomfort. Acute, if strangulated. May be entirely absent.	Usually absent.	May be discomfort.
Description ..	Soft, regular, pos- sibly fluctuant, fixed or slightly movable, red- dened skin and induration about glands. Other glands discrete or coalescent. Tender.		Single, soft, com- pressible, expan- sile pulsating mass; usually no skin involvement though occasion- ally some indu- ration. Thrill and bruit. Tem- porarily occluded by pressure on main vessel.	Single, freely mov- able, regular mass with no in- volvement of overlying skin. May, at times, be well drawn down to, or near scrotum. Impulse on coughing slight or absent.	Single, soft, regular mass, usually slight- ly movable, size in- creased on standing and upon coughing. Impulse may be seen and felt. No skin involvement though it may be tense and shiny. If incarcerated or strangulated, pain- ful on pressure, May or may not be "gurgling sound," on auscultation.	Single, soft, or fairly hard, fixed and semifluctu- ant. No skin in- volvement.	Single or multiple, rather hard, reg- ular and mov- able, discrete. No skin involve- ment. May be slight impulse.
Special data .	May be of gonor- rhea origin. Ex- amination of urethral pus.		History. Positive Wassermann re- action.	If torsion, may be vomiting.	If strangulated, usu- ally vomiting. If large, may be inter- current indigestion.	May be diffuse tu- berculosis else- where, with usu- al signs.	May be vomiting, if twisted.

* For chronic adenitis, hyperplasia and hypertrophy, Hodgkin's disease, malignant tumors, lymphatic leukemia, tuberculous and syphilis, see "Differen- tial Diagnosis of Conditions Causing Generalized Enlargements of Lymph Glands."

CHAPTER XVII

PERITONEUM, MESENTERY, OMENTUM AND RETROPERITONEAL LYMPH-NODES

AFFECTIONS OF THE PERITONEUM



Inflammatory Conditions

Aseptic peritonitis is a non-infective type of peritonitis resulting from trauma, intraperitoneal hemorrhage, and from the escape of sterile fluids into the peritoneal cavity, such as the contents of ovarian or other cysts and pancreatic juices. To understand this condition, it must be appreciated that the peritoneum is exceedingly sensitive to any foreign material, even blood, and that it reacts according to the irritation imposed on it. The physical signs are those of either localized or diffuse peritonitis. An aseptic peritonitis may develop into the infective type.

Trauma causes aseptic peritonitis in non-penetrating injuries of the abdominal wall. The most frequent basis is intraperitoneal hemorrhage from lacerations of the peritoneum or mesentery or rupture of the liver or spleen. Sometimes, however, the peritonitis is the result, solely, of an unusually severe blow, or it may be associated with a contusion of the viscera, especially the intestine.

The intraperitoneal hemorrhage of ruptured ectopic pregnancy will also excite pelvic or more diffuse peritonitis. The pancreatic secretions released in acute pancreatitis are extremely irritating and typical areas of *fat necrosis* result, chiefly in the omentum. The peritoneum will also frequently react to purely aseptic phenomena, such as in torsion of the pedicle of an ovarian cyst; torsion of the omentum and ruptured cysts; and to occurrences such as volvulus and intussusception, which in the early stages are non-infective in character. In some of these, the recognition of peritonitis of an aseptic nature is inferential. In others, such as that following trauma, the truth following such an assumption may be doubtful. Realizing the frequency of subsequent infection, the diagnosis of aseptic peritonitis can only be adhered to when the clinical picture is recessional—that is, when there is a gradual tendency toward abatement of the signs and symptoms, and a final favorable termination.

Acute Infective Peritonitis.—*Acute localized peritonitis* takes place about inflamed viscera; about threatened sites of perforation of the hollow organs; it may also be caused by trauma. With the exception of the latter cause, it takes place by continuity. In addition to injection and swelling of the regional peritoneum, adhesions are usually quickly formed and the omentum is frequently adherent about the affected area and shares in the inflammatory reaction. Because of these protective features, an abscess may subsequently be walled off from the remainder of the peritoneum, and may remain so, or may be discharged through the intestinal tract or may rupture into the general peritoneal cavity. Excluding the pulse and temperature which are notoriously undependable, regional peritonitis is best indicated by the extent of rigidity and tenderness. With abscess production, a mass may be felt or palpation may give the impression of an indefinite tumefaction; the leukocyte count is usually high. At times, the mass may be visible, causing an asymmetry of the abdomen, and the abdominal wall may be thickened and edematous. Vaginal or rectal examination is sometimes the only method by which the mass may be felt. Tenderness is then usually marked.

Acute diffuse peritonitis results when large quantities of infective material are suddenly thrown into the general peritoneal cavity, or when a local peritoneal reaction about an infected area or organ fails in its mission to exclude and wall off such agencies. Thus, perforations of the stomach, intestine, gall-bladder and intraperitoneal rupture of the urinary bladder will frequently occasion immediate peritonitis of the diffuse type. Likewise, local infective peritonitis about a gangrenous appendix or gall-bladder may gradually or quickly spread to adjacent peritoneal surfaces and become diffuse in character; or, an infected ovarian cyst or pyosalpinx may rupture suddenly through its wall and deluge a large portion of the peritoneum with its highly infective material. In all of these occurrences there is a demonstrable etiologic source and, since these conditions are in the majority, diffuse peritonitis is usually a sequel of some preceding intra-abdominal disease, and is therefore a secondary process. There remains, however, a group of instances in which the peritonitis cannot be traced to an offending organ in anatomic relation with the peritoneum; and, in this group, embracing septicemic infections, the ensuing peritonitis may be considered *primary*, since the source of entry is not commonly demonstrable. Yet, for the most part, acute diffuse peritonitis is *secondary* and, from the viewpoint of clinical thoroughness, as well as from the

standpoint of planning operative procedure, it is important to trace the source, when at all possible.

Before considering these types, it is advisable to have the *clinical aspects* of diffuse or generalized peritonitis well in mind. One may be temporarily misled by the air of alertness and keen mentality of the afflicted patient, but there is to be observed a strained, anxious look. This air of apprehension, the pinched features, sunken and dark-rimmed eyeballs, flushed or pallid cheeks and dry-coated tongue mirror the gravity of the abdominal condition. The pulse is rapid, often of poor quality and the temperature is, as a rule, elevated. There are two types of peritonitic abdomens; in one, of grave import, there is retraction with diffuse muscular rigidity of such a degree that the abdominal contour is flat or scaphoid, frequently with clear surface delineations of the various muscles and their tendinous intersections. In the other, also with diffuse rigidity, there is distention of varying degree; at times, there is such great distention that the examiner at once realizes that laparotomy would be akin to the pricking of a balloon—and just as destructive. Tenderness is scattered and extreme, often greatest over the source of infection. Subjectively the chief symptoms are pain and repeated vomiting, to which is often added difficulty in bowel evacuation, due to a reflex ileus. Leukocytosis is usually present.

Many departures from the above may occur, depending upon the source of infection, the virulence of the causative agent and the stage at which the patient is observed. The retracted belly of the early stages of perforative peritonitis will later become a distended one; the normal or subnormal temperature which usually accompanies the onset of the perforative variety of peritonitis will later rise, and the thready, rapid pulse and other signs of shock will recede, providing the condition is not rapidly fatal. The temperature reaction of a well-developed general peritonitis may not be far from normal but its swinging septic type is significant. Leukocytosis may or may not be present although polymorphonuclear increase is practically constant. Pain, vomiting, diffuse rigidity and tenderness then are the essential diagnostic features; abdominal examination, too, is frequently far from satisfactory because of the extensive pain and apprehension. Stupor occasionally replaces the usual heightened mental perceptions. Restlessness is often marked, but is usually confined to tossing movements of the head and arms. Rarely does it disturb the flexed position of the lower extremities or cause the patient to change from the dorsal decubitus. The source of the diffuse peritonitis will often be dubious. Elements in the past history or in the mode of onset will, sometimes, be of the greatest aid. Fortunately, from the objective standpoint, it frequently happens that the greatest rigidity and tenderness overlie the source of infection and this area, at times, will also be the site of the patient's greatest pain.

Primary peritonitis will always be an obscure clinical condition and the diagnosis can rarely be made, unless the peritonitis occurs during the course of an evident septicemia; otherwise, it may be only suspected when there is no demonstrable extra- or intra-abdominal source; this means that there are no significant features in the past history; that the mode of onset is atypical for every possible intra-abdominal source; and that the physical findings are characteristic of diffuse peritonitis though they do not, in any way, lend themselves toward suspicion of any of the viscera.

Since the variations of acute intra-abdominal lesions are so numerous, it will be readily appreciated that the difficulties of such a diagnosis are actually stupendous. If, *in a child*, all of the above-cited conditions are fulfilled, if the peritonitis is acute and diffuse from the onset and never localized, whether by pain or by examination, then the diagnosis of *pneumococcic peritonitis* may be ventured. Some observers lay stress upon early signs of flank dullness. Preceding or coexistent pneumonia will be highly suggestive.

Acute diffuse peritonitis, when produced by perforations of the intestinal tract and stomach, is the type which, above all others, is accompanied by a retracted belly, and it is characteristic that the generalized rigidity is unremitting and persistent, boardlike in nature and associated with costal breathing and flexed knees. Severe shock is an occasional accompaniment; if cases were seen at the moment of perforation, some degree of shock would probably be present, not necessarily with rapid, feeble pulse, but at least with a pulse of poor quality and tension, and moist, chilled skin. The interval elapsing between perforation and the time of examination is usually sufficient to stabilize somewhat the disturbed vasomotor and reflex functions, and more commonly the patient is then observed with a fairly good pulse not far above normal and with normal or slightly subnormal temperature. The history of onset is of a sudden, terrific pain of knifelike or tearing character, located over the site of perforation or very frequently about the umbilicus. Tenderness is found in numerous areas, but, if carefully sought, will be found greatest over the site of perforation. Cautious palpation is thus of the greatest importance, since the previous history of the patient may in no way suggest the existence of a gastric or duodenal ulcer. For example, these "silent ulcers" certainly terminate many times in perforation, and unless palpation is thorough, and includes the entire abdomen, a vicarious point of unusual tenderness, such as the right iliac fossa, may be interpreted as the site of perforation, while the actual site is about the pylorus. A good rule to remember is that diffuse peritonitis of appendical origin will rarely be accompanied by extreme epigastric tenderness, whereas iliac tenderness is a common accompaniment of acute perforations of the appendix.

In later stages the temperature rises, distention occurs and vomiting takes place; and, if unrelieved, the patient presents the classical signs of diffuse peritonitis in respect to constitutional reaction, facies and abdominal findings.

Perforations of the lower intestinal tract, *i.e.*, typhoidal, dysenteric, syphilitic, malignant and tuberculous ulcerations; diverticulitis, various types of obstruction with sloughing secondary to mesenteric thrombosis occasion similar signs and symptoms, modified somewhat according to the nature of the original disease.

In all perforations, with the possible exception of those occurring during typhoid fever, early leukocytosis takes place. An extremely valuable sign, when a gradual advance of the peritonitis is noted, is the obliteration of liver dullness, due to the extra-intestinal escape of gas.

Gall-bladder, urinary bladder, infected ovarian cysts, pyosalpinx, appendicitis and abscess formations may all, when suddenly rupturing, cause diffuse peritonitis, infective in nature. The diagnosis will depend largely upon the previous history, observations and the discovery of increased rigidity and tenderness over one particular area.

In the female, one should always consider that diffuse peritonitis may be

puerperal. Relationship between childbirth, miscarriage or abortion should be sought and the possibility of uterine instrumentation investigated. Needless to remark, deceit is common.

In conclusion, it should be emphasized that the "typical" case of diffuse peritonitis with *hippocratic facies*, and so forth, is an advanced one.

Chronic Peritonitis.—*Chronic localized peritonitis* is essentially non-infective. It represents late stages of reparative processes, for example, after an infective or aseptic peritonitis from which the patient has recovered; or, as the result of a chronic peritoneal irritation, such as may be found about persistent gastric or duodenal ulcers, chronic appendicitis, old pelvic inflammatory disease, foreign bodies, intra-intestinal malignant tumors and diverticula which have been or are subject to inflammation. This variety of peritonitis takes the form of adhesions which bind peritoneal surfaces together or attach the peritoneum to viscera. In some instances the situation and density of these adhesions interfere considerably with function of the affected organs. The gastro-intestinal tract is chiefly involved and in addition to symptoms directly referable to these structures, the patient may complain of pain upon various motions, which involve the abdominal musculature, or which affect the intra-abdominal tension and increase the mobility of the contained organs, such as deep inspiration, holding the breath, straining and lifting. A common complaint is of a "tugging" sensation.

In these conditions, an actual inflammatory process only exists providing the source of irritation or possible low-grade infection remains active. There are, however, varieties of chronic peritonitis, localized or diffused, in which the peritoneum is constantly inflamed. Hyperplastic, adhesive or fibrous and ascitic forms are described. When fluid is present it may be either free or encysted. In some cases of chronic peritonitis, the omentum is shrunken and contracted and may be felt as a firm, oblong or bandlike mass. Chronic inflammation of other serous structures, the pericardium and pleura, may be associated with the peritoneal involvement. This combined affection, adhesive pericarditis and ascitic peritonitis, is frequently referred to as *Pick's disease*.

Tuberculous Peritonitis

Tuberculous peritonitis occurs in three forms, the adhesive or fibrous type, the ascitic or fluid type and the encysted form. It may be a primary condition, that is, without a discoverable focus in any part of the body; or it may be secondary to an intestinal, tubal or retroperitoneal lymph-node tuberculosis. It is most commonly found in children and young adults.

The general symptoms include gradual loss of weight and strength, afternoon rise in temperature, sweating and malaise. The abdominal symptoms embrace disturbances of the gastro-intestinal tract, such as indigestion, loss of appetite, fullness and distress after eating, nausea, vomiting, constipation or attacks of diarrhea and, sometimes, a vague, grumbling abdominal pain which is quite frequently referred to the appendix region, or which may be more or less diffuse and unlocalized.

In the *fibrous* or adhesive type, dense bands of fibrous tissue exist about the intestinal and parietal peritoneal surfaces, matting the coils of gut together and often encircling and distorting them. Thus upon occasions, one may notice a

DIFFERENTIAL DIAGNOSIS OF ASCITES FROM OTHER

Symptom	Ascites	Ovarian Cyst (Large)	Uterine Fibroid
Onset	Fairly rapid or very gradual, depending on cause.	Usually very gradual.	Very gradual.
Abdominal inspection	Symmetrical and uniform enlargement of entire abdomen. On recumbent position, flanks bulge and abdominal wall may flatten in center. When sitting or standing, bulge in lower portion of abdomen. Dilatation of veins with caput medusæ present. Skin often jaundiced and parchment like.	Asymmetrical, unless in very large cysts, in which case it may be symmetrical. Remains globular and prominent in all positions.	Globular or irregular tumor, in midline, prominent in all positions. Often apparently emanating from suprapubic region.
Abdominal palpation	Non-circumscribed outline, no irregularity (though if caused by tumors or liver conditions, regularities of underlying conditions may be felt), soft and fluctuant. When abdomen becomes markedly distended with fluid, it may be tense.	Oval or globular tumor often with irregularities, usually tense. Aortic pulsation may be transmitted.	Hard often nodular tumor, usually globular or oval and which moves with uterus. Aortic pulsation may be transmitted.
Abdominal percussion	When recumbent, resonance in front of abdomen with dullness in flanks. When erect, tympany in upper segments with dullness in lower. Transmitted succussion wave.	Central dullness with surrounding tympany; when free fluid accompanies cyst, sharp deep tap on abdominal wall may reveal outline of cyst wall.	Central dullness with surrounding tympany
Special data ..	For causes, see Etiologic Chart "Ascites." Without anasarca, usually due to liver cirrhosis or portal obstruction such as tumors. With anasarca due to renal or cardiac disease. General health impaired from onset of ascites. When present, edema of extremities bilateral.	Vaginal examination of importance. Health, as a rule, good, until cyst becomes large. When present, edema of extremities unilateral.	Vaginal examination of importance. Tumor usually moves with cervix.

symmetrical or asymmetrical abdominal distention, and because of emaciation, that most significant indicator of intestinal obstruction, visible peristalsis may be observed. It is in the fibrous form that attacks of what appear to be intestinal obstruction occur so frequently, with repeated vomiting, progressive distention and increasing difficulty in emptying the bowels. In the intervals between these attacks, constipation and gastric disturbances are the principal symptoms. The radiographic findings in adhesive tuberculous peritonitis are decidedly characteristic, the opaque material being gathered in the central portion of the abdomen, the intestinal coils

CONDITIONS CAUSING ABDOMINAL ENLARGEMENT

Pancreatic Cyst	Urinary Retention	Pregnancy	Meteorism	Dilatation of Stomach
Very gradual.	Rapid.	Gradual.	Rapid.	Rapid or gradual
Globular mass in epigastrium. Symmetrical enlargement. Prominent in all positions.	Symmetrical enlargement in pubic region extending upward, remaining prominent in all positions.	Symmetrical tumor in midline, verging upward from pubic region. Remains prominent in all positions.	Symmetrical and diffuse enlargement of abdomen, unchanged by posture.	Usually asymmetrical appearing abdomen, extending from epigastrium downward and verging toward the left.
Semifluctuant or tense, at times slightly movable more or less globular tumor. At times outline cannot be distinguished. Aortic pulsation ceases in knee-chest position.	Usually semifluctuant or tense oval mass in suprapubic region.	A firm, usually somewhat movable, regular mass of solid consistency, often fetal parts and fetal movements may be felt.	Tense abdomen without any outline of tumor.	Tense abdomen.
Central dullness with surrounding tympany in epigastrium.	Dullness in suprapubic region, with tympany above.	Central dullness with surrounding tympany.	Diffuse tympany.	Diffuse tympany.
Inflation of stomach and colon often causes dullness to disappear. May be hyperglycemia.	Mass disappears on catheterization. Examine for cause.	Signs of pregnancy.	Examine for cause.	Examine for cause.

evidently being closely adherent. The abdomen is sometimes doughy on palpation.

In the *ascitic* or effusive type, a large amount of free fluid is found within the peritoneum. This gives rise, in addition to the symptoms mentioned, to gradual increase in the size of the abdomen. Upon examination of the abdomen the skin is tense and shiny, the superficial veins are often dilated and there is dullness in the flanks which shifts with change of position. In the recumbent posture, there is tympany anteriorly and this is replaced by dullness over the lower abdomen, when the sitting or erect posture is assumed. The contrast at first glance between the

protuberant abdomen and the generalized thin appearance of the patient is often striking.

Instead of free fluid within the peritoneum, an *encysted* collection may be formed and this may occur in association with either of the usual forms of tuberculous peritonitis. In such an event an elastic, rounded or oval mass is observed, usually dull on percussion, surrounded by intestinal tympany, and not tender upon pressure. More rarely encountered, is a tuberculous abscess, the signs of which are similar, although the consistence may be greater and there may be somewhat marked tenderness because of secondary infection. Recourse to subcutaneous tuberculin tests will seldom be necessary in any of these conditions, although diagnosis may rarely be incomplete without it. Associated findings, the history and the clinical course usually suffice. In infants, the von Pirquet reaction is of value.

The disease is essentially chronic, but may be either acute or subacute. In exceptional instances, confusion with chronic non-tuberculous peritonitis will arise. Rectal and vaginal examinations may detect suggestive signs of tuberculosis in the uterine adnexa or in the retroperitoneal nodes.

At times, nodular masses (peritoneal nodules or tuberculous retroperitoneal glands) may be palpated. These may appear singly or they may be multiple; they are fixed and firm in consistency. The accompanying ascites suggests malignancy, obviously, and the diagnosis between the two may be difficult. Upon paracentesis the fluid obtained is clear and straw-colored or pale. Guinea-pig inoculation is sometimes valuable.

Tumors

Benign tumors of the peritoneum are: *Fibroma*, *angioma*, and *chondroma*. They are extremely rare and are not likely to attain a large size. There are no accurate diagnostic data.

Malignant tumors are almost always secondary. Primary *sarcoma* and *endothelioma* do occur, but are extremely rare. *Carcinoma* is the most frequent malignant affection of the peritoneum; it arises secondarily to gastric and ovarian carcinomata, as a rule, although its source may be in any of the abdominal or pelvic organs, in the retroperitoneum or in more distant locations, such as the breast and pleura. The usual peritoneal reaction to malignancy is a profuse outpouring of fluid, so that signs of free fluid are noted. Occasionally, firm, nodular masses may be palpated. Upon paracentesis, usually a blood-tinged fluid is obtained. The symptoms include gastro-intestinal disturbances, abdominal pain and discomfort, loss of weight and gradual increase in the size of the abdomen. Malignancy most commonly occurs in middle and advanced age, times of life when tuberculous peritonitis, with which it may be easily confused, is rather infrequent.

Cysts

Cysts of the peritoneum are infrequent, and arise chiefly in the mesentery. *Hemorrhagic*, *serous*, *chylous* and *dermoid* cysts do occur in the general peritoneum, and echinococcus cysts may be primary there, as well. Also, cysts sometimes form in the remnants of fetal structures, such as the urachus and omphalomesenteric duct. Symptoms only appear when the cyst is sufficiently large to exert pressure upon regional nerves and intestinal loops; they consist of pain, dragging sensations

and gastro-intestinal disturbances. When near the abdominal wall a tense or fluctuant regular mass may be felt, dull on percussion with tympany surrounding it. Echinococcus cysts may be multiple, and frequently incite the production of ascites.

AFFECTIONS OF THE MESENTERY

Inflammatory conditions	acute localized diffuse chronic localized diffuse
Granulomata	tuberculosis syphilis (gumma)
Hodgkin's disease	
Mesenteric thrombosis	
Mesenteric cysts	hemorrhagic serous parasitic dermoid
Tumors	benign lipoma fibroma myofibroma malignant sarcoma carcinoma teratoma
Mesenteric nodes—acute lymphadenitis	

Inflammatory Conditions

The mesentery, like the peritoneum, shares in many inflammatory conditions, localized or diffuse, acute or chronic. By extension it is also involved in retroperitoneal inflammations and infections. These are purely pathologic conditions, not characterized by any particular clinical evidence. Retroperitoneal abscesses originating in the perinephritic area, about the vertebral bodies in the subhepatic or retrocolonic areas, may bulge forward into the mesentery and may rupture through its leaves, causing peritonitis. The symptoms in general are those of a retroperitoneal tumor, and of concealed pus.

Granulomata

Tuberculosis of the mesenteric glands occurs in association with intestinal and peritoneal tuberculosis, but may be found alone. Children are affected principally in the latter type. Deep-seated nodular masses are felt through the abdomen, confluent in the later stages, discrete in the early. In some, the onset is acute, with a tender and somewhat rigid abdomen, vomiting, pain and temperature. The localizing signs on the right side of the abdomen suggest appendicitis, and many cases are operated upon with this diagnosis. This condition is known as *tabes mesenterica*.

Gumma of the mesentery has been described. It cannot be differentiated from

a retroperitoneal tumor, even when the Wassermann reaction is positive. Without laparotomy, the only diagnostic test is its disappearance under treatment. It is exceedingly rare.

Hodgkin's Disease

Hodgkin's disease affects the mesenteric glands, either as a primary involvement or in the course of the disease after the involvement of other lymphatic chains. Examination of the abdomen may show single or multiple, firm, deep-seated masses, or the glands may only be felt by the rectum. Their recognition by this method furnishes valuable corroborative information in suspected cases of Hodgkin's disease with glandular enlargements elsewhere.

Mesenteric Thrombosis

Mesenteric thrombosis takes place in certain suppurative conditions of intra-peritoneal origin. Beginning with a thrombus of the distal vessels, an ascending infection develops which leads to *pylephlebitis* following acute appendicitis, for example. Occlusion of the mesenteric vessels is also caused by volvulus, internal strangulation and other affections in which the vessels are violently and suddenly compressed. Apart from these incidental relationships, mesenteric occlusion occurs as a clinical condition which is not readily diagnosed. The first premise in a diagnosis is the discovery of a probable source of thrombus or embolus. The onset is ushered in with acute, generalized, very severe abdominal pain, associated with vomiting and general abdominal rigidity. The picture rapidly becomes that of an acute intestinal obstruction, from which a mesenteric vascular occlusion cannot be differentiated, unless a basis for it is found. Abdominal distention is often a late sign.

Mesenteric Cysts

Mesenteric cysts may arise in persistent fetal structures or are developmental. True mesenteric cysts are the *hemorrhagic*, *serous*, *parasitic* and *dermoid* cysts and, at times, they attain large size. In some, they produce no symptoms; in others, pain and pressure sensations and disturbances of digestion; in a third class, the symptoms of intestinal obstruction. A tense, deep-seated mass is occasionally palpated which is somewhat movable, transversely. As most of them are located in the mesentery of the small gut, the mass is felt below and to the right of the umbilicus. Occasionally, it is located to the left of the navel, in the mesosigmoid. The mass, pushing forward, is surrounded by tympany. Accurate palpation is decidedly difficult, hence the diagnosis of mesenteric cysts is not usually made.

Acute lymphadenitis of the mesenteric nodes takes place in conjunction with many inflammatory and suppurative intra-abdominal affections, particularly those of the appendix. It is apparent only at operation.

Tumors

Retroperitoneal and mesenteric tumors appear to be identical from the clinical standpoint. Lipoma, fibroma, myofibroma and sarcoma occur; they may grow slowly or rapidly, and often attain large size. Pressure pain in the back or

deeply within the abdomen, neuritic pains along the compressed descending nerves, and vascular disturbances in the lower extremities, also due to compression of the large vessels, are important symptoms. As the growth advances there are gastrointestinal disturbances. In both the benign and malignant forms when large, loss of weight and strength are common. Upon palpation, a deep-seated mass, whose consistency varies according to its composition, is felt; it is usually firm and immovable, with intestinal tympany in front of it. These tumors are, as a rule, located in the right side of the abdomen. The *nodes* are frequently involved secondarily from a primary intraperitoneal or retroperitoneal carcinoma. Teratoid tumors appear, similarly, and usually become malignant.

ETIOLOGY OF ASCITES

Due to obstruction of portal circulation	diseases of liver	- atrophic cirrhosis - abscess - echinococcus cyst - neoplasms - perihepatitis - pylephlebitis - thrombosis of portal vein - syphilis - Banti's disease - leukemia (rare) - splenic anemia
	abdominal tumors compressing especially vena cava or portal vein	- gastric malignant tumors - retroperitoneal sarcomata - mesenteric cysts - pancreatic cysts - enlarged retroperitoneal lymph glands (especially sarcoma) - ovarian and uterine tumors, impacted into the pelvis - abdominal aneurysm
Of peritoneal origin		
- simple proliferative peritonitis - neoplasms of peritoneum, especially carcinoma - tuberculosis of peritoneum		
Due to obstruction of receptaculum chyli or duct leading from it	from without	- neoplasms - aneurysm - constricting bands - syphilis - tuberculosis - mesenteric cysts
	from within	- tuberculosis - syphilis - angiomatous disease of lymph glands - neoplasms <i>Filaria sanguinis hominis</i> infection
Of cardiac origin		
- myocardial insufficiency - chronic adhesive pericarditis - mitral stenosis - pulmonary emphysema, secondarily weakening heart and pulmonary circulation		
Of renal origin { nephritis, especially of the chronic type		

AFFECTIONS OF THE OMENTUM

Congenital malformations	{ bands persistent embryologic membranes rudimentary formation
Injuries	{ gunshot or stab wounds crushing
Inflammation (epiploitis)	{ same as in peritoneum
Cysts	{ mesenteric omental cysts
Hernia	(See section on "Hernia.")
Tumors	{ endothelioma lipoma fibromyoma sarcoma carcinoma
Strangulation	{ in hernia
Torsion	{ free or adherent

Appreciable knowledge of the physiology of the omentum is still lacking, while the pathologic and surgical aspects are not far beyond the experimental stage. The most important work in recent years has been done by H. Florey and H. M. Carleton who conclude that the omentum is totally incapable of any intrinsic activity, but is moved passively by changes in posture, by movements of the diaphragm and by peristalsis of the intestines. The omentum has quicker and greater ability to form fibrin than the peritoneum. Thus the powers of adhesion and encapsulation are intrinsic, but the movements of the omentum are passive and intrinsic.

Congenital Malformations

Congenital malformations of the omentum, usually in the form either of *bands* or *persistent membranes*, may so alter its shape as to destroy its protective mechanism or cause angulating and injurious pressure on the intestines. They are recognized before operation only by skillfully taken radiographs. They may, indeed, be incapable of demonstration. The omentum is occasionally the site of *rudimentary* development.

Injuries

Isolated injuries of the omentum are extremely rare. Hemorrhage is the only immediate result.

Inflammation

Inflammation of the omentum results from various types of peritonitis. All stages may be exhibited, from superficial injection, to swelling and engorgement, and even gangrene. The fat necrosis of acute pancreatitis is beautifully illustrated in the omentum. In tuberculosis and non-tuberculous peritonitis, the omentum becomes shrunken, firm and hard and can be palpated, in some cases, as a dense,

bandlike structure extending transversely across the abdomen. Omental adhesions, if not congenital, are the result of inflammatory conditions or due to an extension of malignancy.

Cysts

True cysts arise from within the cavity of the great omentum. They may result from degeneration of lymph glands, lymph blocking, hematomata, embryonic rests or developmental errors. Neoplasms and fetal inclusions have been reported, but all omental cysts are rare. One-half of the reported cases have been in children under ten years of age (DeCosta). There are no characteristic symptoms and such cysts are rarely diagnosed.

Hernia

Hernia of the omentum is very common. In the case of an umbilical hernia, the omentum is found in the protrusion, in practically every case. This same condition is frequently present in an inguinal hernia where nearly the whole omentum may pass through the canal into the scrotum. Incarceration or strangulation may occur. If the distal portion becomes adherent to the hernial sac, the entire omentum may be twisted upon itself. This condition was found in a recent case, where four distinct torsions were released. An inguinal hernia had been present for several years, but for three days reduction had been impossible. Tenderness was marked over the inguinal region, but other symptoms were not pronounced. Neither vomiting nor constipation was present.

Tumors

Primary tumors of the omentum are rare. Endothelioma, lipoma and sarcoma have been described. When of large size, they are felt beneath the abdominal wall as firm or soft tumors, dull on percussion. Intestinal and other visceral origin must be eliminated, clinically and radiographically, before making the diagnosis. Theoretically, the tumor should be easily displaced, possibly both vertically and from side to side, but this feature is not, as a rule, observed. Secondary malignant tumors involve the omentum, just as they do the general peritoneum.

A case of primary multiple fibromyoma of the omentum was reported by the author in 1917. It occurred in a colored woman of twenty-eight who was operated upon for bilateral pyosalpinx, which diagnosis was found to be correct. On opening the abdominal cavity it was seen that the whole surface of the greater omentum from the gastric border to the free margin was riddled with hundreds of hard nodules which varied in size from that of a millet seed to that of a large English walnut; it resembled, indeed, in all respects, an omentum which was the site of secondary transplantations or metastases.

It was impossible to state the origin of this growth. The one theory above all others which seemed the most logical was that the omentum, in this case at least, contained primary muscle-fibers which, upon the action of some stimulus, formed into tumor growths.

Torsion

Torsion of the great omentum is a rather unusual condition. Mechanically torsion is dependent upon a point of fixation beyond its normal attachments.

Adherence of the omentum to a previously diseased area, the result of acute or chronic affections of the peritoneum, affords this basis for torsion.

The onset is acute, with sharp pain, sometimes of a colicky type and occasionally accompanied by some degree of shock. The abdomen becomes distended, and tenderness and rigidity are present, usually most pronounced over the right lower abdominal quadrant. A mass may or may not be felt. Vomiting occurs and there is difficulty in bowel movements. The omentum twists upon itself several times, as a rule, usually with some bleeding, and with ultimate gangrene from vascular obstruction, if not relieved. Torsion occurs most often in obese patients with excessive intra-abdominal fat.

AFFECTIONS OF THE RETROPERITONEAL LYMPH-NODES

The retroperitoneal lymph-nodes have been little studied as a separate, distinct field of disease. It is conceivable that they become acutely inflamed when draining areas of infection and are affected as are other lymph-nodes in the general diseases which affect the lymphatic system. A mixed-cell sarcoma, arising especially in the lymph-nodes of the retroperitoneal region, has been noted by MacCallum. Huge masses are formed, which are rapidly growing. A myxomatous tumor is also found in this region, forming large masses which push forward from the rest of the mesentery separating the abdominal organs. Recurrence is the rule after removal, and metastases are common in the liver and other organs.

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CHAPTER XVIII

STOMACH, DUODENUM AND SMALL INTESTINE

AFFECTIONS OF THE STOMACH

- Congenital anomalies { transposition
pyloric stenosis (congenital)
- Cardiospasm
- Inflammatory conditions { acute gastritis { simple
toxic
phlegmonous
chronic gastritis
perigastric abscess
- Achylia gastrica
- Achlorhydria
- Acute dilatation
- Foreign bodies
- Ptosis
- Gastric ulcer { superficial (Dieulafoy)
acute { fulminating
severe
slight hematemesis
severe (without recurrences)
chronic, indurated
with perforation
- Granulomata { actinomycosis
tuberculosis
syphilis
- Tumors { benign { lipoma
myoma
fibroma
adenoma
lymphadenoma
malignant { carcinoma
sarcoma
endothelioma
- Hour-glass stomach

Congenital Anomalies

Transposition is merely mentioned as a congenital anomaly from the possibility of its existence as a definite entity.

Congenital pyloric stenosis (*hypertrophic pyloric stenosis*) is a condition usually appearing during the first few weeks of infancy, and has become recognized as a definite surgical condition. An early diagnosis is essential in curing this condition and hence a symptom-complex of the disease is of the utmost importance to consider.

Projectile vomiting soon after eating, with an infrequency and smallness of the stool, and gradual emaciation, are usually the first symptoms noted. The child appears very hungry and upon the taking of food, ejection is immediate or a short time after its ingestion. Rhythmic peristaltic contractions over the abdomen are noted and a small tumor mass slightly to the right of the midline over the right upper abdominal quadrant is almost constantly found during peristalsis. Radiography and fluoroscopy confirm the diagnosis, which in itself, and even without these aids, is not difficult.

Cardiospasm

This condition is a spasm of the musculature of the cardia and is caused by a local irritation or reflex condition. Occasionally it may be due to spasm of the sphincter of the esophagus. It is of the neurotic type. A complete or partial obstruction to the passage of food into the stomach occurs. The spasm may be present for a sufficient length of time to produce a true hypertrophy with subsequent dilatation of the esophagus or it may be so transient and so infrequent as to cause no dilatation. The symptoms may be slight, or they may assume such proportions as to cause an actual emaciation of the patient, due to the inability of the food to gain access to the stomach. Marked difficulty in swallowing food (solid) and a rather rapid regurgitation of that food taken is most pronounced. Vomiting of food taken many hours before shows, at times, an apparent absence of the gastric juice. A sense of discomfort usually exists over the stomach and low esophageal areas, which, at times, becomes intense. Interference with breathing may be marked or slight and, at times, may lead to a true dyspnea. The delay or absence of the swallowing sound is one of the pathognomonic symptoms, and the passing of esophageal bougies with a definite resistance at the lower end of the esophagus is common. A cardiospasm caused by definite organic disease exists. A pure neurosis, causing a cardiospasm attack, is of sudden onset and usually occurs during the ingestion of food.

Inflammatory Conditions

Acute Gastritis.—This is an acute involvement of the gastric mucosa with resulting disturbances of digestion. Pathologically it may be divided into the simple, toxic and phlegmonous types; the first type occurs the most frequently.

Simple.—This condition may be primary, in which case it is due to an irritant (mechanical, chemical or thermal). It is often caused by an indiscretion in diet in which instance too large an amount of food has been taken; this in itself may cause an acute disturbance of the gastric ferments. Simple gastritis may also be secondary, especially to the acute infectious diseases.

The signs and symptoms vary, depending upon the severity of the attack and the etiologic factors entering into the case. Belching of gas and a sense of fullness and discomfort in the epigastrium, occasionally accompanied by nausea and vomiting, are the most prominent symptoms. On palpation of the stomach a dilatation of that organ is generally noted and slight tenderness on pressure is usually observed. Constipation or diarrhea may be present. The attack usually subsides after from one to three days and is generally relieved by alkalies, emetics and catharsis.

In the more acute cases, severe nausea, vomiting, high temperature and general constitutional disturbances are frequent, and slight herpes of the lip are often present.

In childhood, acute gastritis is generally associated with a definite enteritis.

Toxic gastritis is a condition, the result of swallowing corrosive substances which destroy the stomach mucosa, submucosa or even muscularis. The most commonly employed substances are the concentrated mineral acids (nitric, sulphuric), the strong alkalies (caustic potash, caustic soda), or poisons such as phosphorus or arsenic. The stomach wall is destroyed wherever it comes in contact with the irritant. The main symptom is intense pain in the gastric region, increased on pressure, and often found along the esophagus (under the sternum). Difficulty in swallowing and increased salivation are present. Vomiting occurs early and is persistent, with streaks of blood and even shreds of mucous membrane in the vomitus. The abdomen is tender, seldom distended but more often contracted. Collapse follows with pale, cold skin, rapid and weak pulse and respirations. Death is due to peritonitis, cardiac or respiratory failure or shock. In a more protracted case petechiæ appear in the skin, albumin and blood in the urine; there is jaundice, intestinal ulceration or liver or kidney degeneration.

Phlegmonous gastritis or abscess of the stomach is a rare disease found chiefly in young adult males. The condition may begin as an infection of the mucous membrane (usually by the streptococcus) in which case injury to the mucosa by errors in diet, excessive alcohol or trauma are thought to be factors. More commonly the infection begins in the submucosa as a metastasis from generalized body infection such as pyemia, puerperal infection or one of the exanthemata. There may result a localized abscess or a diffuse purulent infiltration of the stomach wall.

The symptoms have an acute onset without premonitory signs. There is marked pain over the stomach with all the evidences of a severe infection. The temperature varies between 103° and 105°, chills are frequent, the pulse becomes rapid and feeble and jaundice may develop. Vomiting of bile, mucus and food is common; pus is vomited if the abscess breaks into the stomach (which rarely occurs). Pressure over the gastric area elicits tenderness and reveals muscular rigidity. Tympanites and diarrhea are common. The course is rapid, usually taking only a few days. The condition must be differentiated from phrenic and subphrenic abscess which are not so acute; from acute cholecystitis which gives a definite history with physical signs in the gall-bladder region; and from acute pancreatitis in which the temperature is subnormal at first and the tympanites is earlier and more marked. The diagnosis of phlegmonous gastritis is made by the rapid onset of gastric pain and rigidity with high temperature, chills and leukocytosis.

Chronic Gastritis.—Patients with this condition usually give a history of dietetic errors or alcoholism. It may, however, be secondary to gout, diabetes,

nephritis, anemia, or chlorosis and to chronic diseases of the heart and liver. The symptoms are a feeling of distress after meals, of abdominal oppression and perhaps actual pain when the stomach is empty; diffuse, though not severe, pain over the area of the stomach on pressure, is often noted. The appetite is variable, the patient is subject to vertigo, headache and insomnia, also "heart-burn" especially after eating, with eructation of gas. Vomiting after meals, excepting in cases with a history of alcoholism, is not common. The tongue will be swollen, a bad taste present in the mouth and a stomach cough is common. There may be an absence of free HCl and the presence of occult blood; pepsin remains present. Mucus may or may not be found. There is likely to be constipation or diarrhea with an habitual thirst and a congested larynx. This condition is found more commonly in people who are past middle life.

Perigastric abscess is, as a rule, due to a subacute gastric perforation in which a very small amount of gastric juice has slowly seeped into the peritoneal cavity and which is quickly walled off by the peritoneum or omentum. Occasionally, it is a sequela of an inflammatory process of the pancreas. Generally its symptoms are easily recognized and its diagnosis made. The bulging of the epigastrium, tenderness, rise in temperature, leukocytosis, and some tenderness in the presence of or following gastric disturbances, usually make up the symptom-complex. Generally, the signs and symptoms are not of a severe nature, thereby ruling out a pancreatic process.

Achylia Gastrica

This is a very rare functional derangement of the stomach in which the gastric juices are not secreted. The symptoms include indigestion, distress after eating, loss of appetite and loss of weight. While the digestive disturbances are related to meals, they are not associated with pain or periodicity. The diagnosis can only be made by analysis of the gastric contents after a test meal.

Achlorhydria

This is a functional secretory disturbance of the stomach, in which the gastric juice lacks its normal hydrochloric acid content. It is symptomatic in gastric carcinoma, syphilis of the stomach and the various anemias. The patient complains of vague discomfort and fullness in the epigastrium, after eating. Eructations of gas are common, and nausea and vomiting may occur. The symptoms are relieved by small doses of hydrochloric acid taken after meals. The general impression is that of a gastric neurosis, but accurate diagnosis depends upon the chemical analysis of the gastric contents.

Acute Dilatation

Acute dilatation of the stomach or acute ectasia is a condition of acute atony—accompanied by an abnormal distention of the organ. Its causes are multiple, and they may be of a primary or secondary nature. The rapid eating of a large amount of indigestible food, a severe blow over the solar plexus region and visceral manipulation during operations are the main primary etiologic factors. The affection may occur during the course of the infectious diseases, such as influenza, typhoid and

scarlet fevers, pneumonia and the like. It may develop during a prolonged illness such as tuberculosis, the anemias, malignancy and myocardial insufficiency. Post-anesthetic and postpartum acute dilatations of the stomach occasionally develop. The condition occurs most especially in the young adult, though no age is exempt. The symptoms are as follows: Nausea, vomiting, prostration, severe epigastric pain (may be absent); the vomitus is largely fluid and contains little or no hydrochloric acid, but often shows bowel and duodenal secretion and, in spite of persistent vomiting, gastric hypersecretion continues in enormous amounts. The urine is scanty and a dehydration of the tissues is present. There is marked abdominal distention and an especial bulging of the epigastrium. The outline of the stomach may often be seen, the borders of which are greatly beyond their normal limitations.

Foreign Bodies

Foreign bodies gain access to the stomach by way of the mouth, or through a penetrating abdominal wound (infrequent). They are especially found in children and in the insane. Coins and other small objects are the usual articles swallowed, but the insane may swallow large objects such as table silver and the like, perhaps with suicidal intent. The possible variety of foreign bodies is almost endless, embracing chiefly, however, coins, buttons, needles and pins, thimbles, fishbones, etc. A very curious type of foreign body is the "hair-ball" which results from the repeated ingestion of hair.

Foreign bodies may produce no symptoms, in fact the smaller ones usually pass through the pylorus without difficulty. Others are responsible for symptoms of chronic gastritis, while large or sharp articles may give rise to gastric hemorrhage or perforation. In some, the symptoms are those of pyloric obstruction. The radiograph is often of diagnostic import, as the history is often misleading.

Ptoxis

Ptoxis of the stomach is a downward displacement of that organ, usually associated with a displacement of other abdominal viscera, such as intestines, kidney, liver and spleen. The location of the lesser curvature is used in determining the exact position because a displaced greater curvature points more towards a gastric dilatation. The cause of most cases is unknown; some are congenital, others acquired from a severe dilatation or tumors. Females are affected from eight to ten times as frequently as males. Most cases occur between eighteen and forty but symptoms may be more marked as the age increases. The chief complaints are nervousness with cardiac, gastro-intestinal or pelvic disturbances. There may be loss of appetite with indigestion, constipation, flatulence, sense of weight in the abdomen or any other complaint referred to the stomach. Headaches and neurasthenia are very common. These patients are usually thin with flaccid abdominal walls which protrude in the suprapubic region when in the erect posture (pot-belly). Palpation and percussion of the stomach area may give valuable information, but a radiogram of the stomach with a barium meal will make the diagnosis exact.

Gastric Ulcer

This affection is of fairly frequent occurrence and is most often found in females between twenty and forty years of age. Age and sex are, however, not determining features, inasmuch as men frequently present the condition.

Poor food, anemia, overwork and trades necessitating constant epigastric pressure, such as shoemaking, horseshoeing and the like, together with the constant tasting of foodstuffs, as by chefs, are all predisposing factors.

Gastric ulcer may be divided into: (1) The superficial (Dieulafoy), (2) the acute, and (3) the chronic indurated.

Superficial Ulceration (*Dieulafoy*).—This affection is characterized by the presence of minute ulcerations of the gastric mucosa from which severe and, at times, fatal hemorrhage has occurred. Its etiology is unknown, though it may very well be caused by those conditions predisposing toward any stomach ulceration. The condition is uncommon and often unrecognized.

It occurs chiefly in the young adult between twenty-five and thirty-five years of age. The previous history generally given by a patient suffering with this condition is usually of a negative nature, there being no mention or perhaps a very minor one of previous indigestion or any other gastric disturbance. On the other hand, Dieulafoy, in describing this affection, holds that a case "representing severe symptoms of hyperacidity but showing actual subacidity should always suggest *ex ulceratio simplex ventriculi*." The sudden appearance of a severe gastric hemorrhage accompanied by all the signs of shock is, as a rule, the presenting sign. The patient may die following the loss of an excessive amount of blood, or may entirely recover. Recurrences of hemorrhage are common.

Acute Gastric Ulcer.—Gastric ulcer of the acute type is often divided into the fulminating, the severe, the slight with hematemesis and the severe without recurrence. One so often blends itself with the other that it is unnecessary to differentiate each particular gradation. A history of previous gastric disturbance is almost always given by the patient. In many of these cases there is a long-standing history of so-called attacks of indigestion or abdominal discomfort, so often in relation to the taking of food. The patient, by the time he consults a surgeon, has probably gone through the gamut of stomach remedies, such as large amounts of bicarbonate of soda, bismuth and the like. On the other hand, the first signs or even the first intimation of the disease may be hematemesis. Pain and discomfort, vomiting, previous attacks of so-called indigestion, abdominal tenderness and usually the vomiting of blood form a symptom-complex of the disease. In order, however, to differentiate the condition, an analysis of these symptoms must be made.

Pain may be entirely absent, though it is usually of diagnostic import. In the acute *fulminating* ulcer there may be none or only a slight sense of epigastric weight and discomfort. In other cases, pain is usually of a sharp, stabbing type, situated in the midepigastrium and radiating through to the back, often to the right shoulder and occasionally to the left arm and shoulder. The particular point of tenderness may be referred to both the midepigastrium and to a point in the back directly on the level with the midepigastritic sensitive area. Pain usually appears early after an ordinary meal; that is, within half an hour or so, especially if the ulceration is situated in the lesser curvature, and usually from one to two

hours after the taking of food if the ulcer is situated in the pyloric antrum. There are cases which are relieved by food, other cases in which there is a marked increase of pain. The acute gastric ulcer, at times, may be relieved by pressure over the epigastrium. If, on the other hand, the ulcer is situated in the posterior epigastric wall, it may be relieved by lying in the prone position; if on the anterior wall, it may possibly be relieved by lying on the back. There are cases, however, in which the pain is only benefited by the administration of alkalies and opiates.

Vomiting is a very variable symptom. Small amounts of gastric secretion, stained or unstained by blood, may be vomited, accompanied by eructations of gas. There are other cases in which vomiting does not enter into the train of symptoms. Hematemesis may be exhibited by the vomiting of large amounts of blood or only a sufficient amount to tinge the vomitus. In the acute fulminating gastric ulcer, hematemesis comes on very suddenly, is very copious and often causes death within a short time. In another type of case classified as *severe*, copious vomiting of blood comes on suddenly without relation to food, to recur within a few hours or days. In another form classified as *slight* with hematemesis, there are varied amounts of blood-stained vomitus, with free intervals of weeks or months, and in the *severe without recurrence* type, there is a copious single hemorrhage of very sudden onset and with no tendency toward recurrence.

Abdominal Examination.—Inspection is usually negative unless there is pyloric obstruction (real or functional).

Palpation.—During an acute attack there is usually a marked rigidity and tenderness over the epigastrium which may extend over most of the abdomen; between attacks, rigidity and tenderness may be entirely absent, though it is usual to find a slight amount of tenderness over the epigastrium in the interval of attacks.

The examination of the gastric contents may be of service in determining a diagnosis, there being usually present an increase in the hydrochloric acid content, together with the presence of red blood-cells.

The examination of the stools may be entirely negative or there may be the temporary finding of both microscopic and occult blood. The constant finding of blood in the feces is more indicative of malignancy.

Radiographic examination is usually of great value in determining the site of the ulceration. There are times, however, when the x-ray is misleading. All cases of suspected gastric ulcer should, however, be radiographed.

Chronic Indurated Gastric Ulcer.—This condition usually occurs later in life than the acute type and appears most especially in the male between thirty and fifty years of age. The patient usually suffers over a long period of time with persistent dyspepsia; the predisposing causes are the same as those indicated in the acute type.

Without stenosis, pain is not as pronounced as in the acute form; if stenosis is present all signs and symptoms are accentuated.

With stenosis, the pain becomes colicky and of the stabbing type in the epigastrium, radiating through to the back and to the right or left shoulder. The pain is, at first, always situated in the midline and, if constant in the back, the pancreas is, as a rule, eroded. Vomiting is of frequent occurrence and, if the stenosis is partial or complete, the vomiting of undigested food is a prominent sign. Hematemesis is

more frequent than in duodenal ulcer and may be of a very copious nature; the bleeding usually ceases spontaneously, however, and the intermittent type of vomiting of blood is a very suggestive factor.

Abdominal Examination.—Inspection.—Peristaltic waves are, as a rule, pronounced, and a definite dilatation of the stomach may be seen, often indicated by an indurated mass situated in the right lower quadrant (pyloric mass)—and a stomach outline, bulging up and beyond the normal gastric limitations.

Palpation.—A mass is often felt in the pyloric region of the stomach and is usually hard and indurated. At times, no mass can be felt.

Gastric Examination.—In about one-half of the cases there is an increase in hydrochloric acid. There may be, however, an entire absence of this content. Food particles, together with pus and red blood-cells, are common. There are usually present products of fermentation. Examination of the stools in this condition is entirely unsatisfactory, though temporary melena may be present. Radiographic examination usually confirms the diagnosis.

DIFFERENTIAL DIAGNOSIS OF CONDITIONS CAUSING ACUTE PAIN IN THE EPIGASTRIC REGION

Coronary thrombosis	}	See Differential Chart, "Differential Diagnosis of Conditions Causing Acute Diffuse Abdominal Pain with Shock."
Gastric ulcer (with perforation)		
Duodenal ulcer (with perforation)		
Acute pancreatitis		
Acute appendicitis		See Differential Chart, "Differential Diagnosis of Conditions Causing Acute Pain in Right Lower Abdominal Quadrant."
Acute cholecystitis	}	See Differential Chart, "Differential Diagnosis of Conditions Causing Acute Pain in the Right Upper Abdominal Quadrant."
Pneumonia		
Cholelithiasis		
Gastric ulcer (without perforation)	}	See Differential Chart, "Differential Diagnosis of Conditions Causing Hematemesis."
Duodenal ulcer (without perforation)		
Acute dilatation of stomach		See Differential Chart, "Differential Diagnosis of Conditions Causing Acute Pain in the Left Upper Abdominal Quadrant."
Acute gastritis		Occurs at any age but most especially in adults. Often follows dietary indiscretion or in the course or following the acute infectious diseases. Common in alcoholics. Pain, sharp and most severe in the epigastrium; at times it is dull and intermittent. Radiation is often to back and to right shoulder; increased upon the taking of food and upon pressure; usually relieved by alkalies. In the very severe type of case, shock may be present. Nausea is present and often severe vomiting; eructations of gas pronounced. Muscular rigidity and tenderness in epigastrium.
Epigastric hernia		Occurs most especially in adult males, often following a severe strain on the abdominal musculature. In the acute cases, pain in the epigastrium is sharp and continuous and with the appearance of a small tumor mass directly over the epigastrium; if incarcerated, nausea and vomiting are present to a moderate degree; if strangulated, nausea and vomiting are almost constant. The mass is either reducible or irreducible.

DIFFERENTIAL DIAGNOSIS OF CONDITIONS CAUSING ACUTE PAIN IN THE EPIGASTRIC REGION
(Continued)

Common bile-duct calculus	Most commonly found in those of middle life. If of the "ball valve" type, pain is very acute and is similar to intermittent attacks of "gall-stone colic." If the calculus completely blocks the duct, pain will gradually become less intense until it disappears, entirely. Unless toxemia is extreme shock is not present. The temperature may be very severe or moderate; it is usually followed or accompanied with chills and resembles the "malarial type" or "hepatic or Charcot's fever," the temperature rising rapidly. In about one hour it becomes 104° or more, remains high for several hours and then drops suddenly to normal. It may remain normal for a few hours, a day, few days or several weeks. Muscular rigidity and tenderness are present in the epigastrium and upper quadrants and less marked over the entire abdomen, when the stone is moving in the duct; usually entirely absent when the stone is lodged in the duct. No mass is present unless there occurs an acute cholangitis, in which instance the liver will be enlarged. If suppuration occurs, there may be a high leukocytosis; bile is found in the blood. Stools, in complete blocking, become clay-colored. Urine usually shows signs of an acute nephritis, and bilirubin is found. If calculus is of the "ball valve" type, there is intermittent jaundice which becomes less and then again deepens; when calculus blocks continuously the duct, there is a permanent and deep jaundice.
Diaphragmatic pleurisy	Often simulates an acute abdominal condition, in that the symptoms are more especially referred to the upper part of the abdomen. Pain is, as a rule, violent and is accompanied by rapid breathing of the thoracic type. Osler states that the intense subjective with trifling objective features are always suggestive. Martinet gives the five cardinal points of tenderness as follows: "(1) Between the two heads of the sternocleidomastoid muscle. (2) Along border of sternum in upper costal interspaces. (3) The diaphragmatic point, at the junction of the sternal line (right or left sternal margin) and the line of prolongation of the bony portion of the tenth rib. (4) The insertions of the diaphragm at the base of the thorax. (5) The spinous processes of the upper cervical vertebræ."
Tabes dorsalis	See Differential Chart, "Differential Diagnosis of Conditions Causing Acute Diffuse Abdominal Pain without Shock."

Perforated Gastric and Duodenal Ulcer

(See Differential Charts, "Acute Abdominal Pain with Shock" and "Hematemesis.")

Granulomata

Actinomycosis.—Mayo Robson (as noted in *Keen's Surgery*, W. B. Saunders Co., 1921, Vol. VI, p. 479) states that the disease in this location is practically

always secondary, though he reports a case which was believed to be primary. The symptoms were pain and discomfort in the upper abdomen with loss of weight. He states that, in this case, pain was not a prominent symptom and there was no apparent relation between the ingestion of food and the symptoms. The skin over the tumor was thickened and edematous and the abdominal swelling was adherent to the anterior abdominal wall. The pus removed from the inflammatory mass contained the granules.

Tuberculosis of the stomach is a very rare affection and is secondary to other tuberculous foci. In the stomach, tuberculosis causes ulceration, and the symptoms and course are those of gastric ulcer. Perforation is not a common sequel, and the ulceration is usually sealed off by a perigastritis. Most cases occur in children and young adults.

It may be difficult to determine the original tuberculous site, and up to the present time there are no unquestioned examples of primary gastric tuberculosis. Usually, bone, joint, intestinal, glandular or pulmonary lesions coexist, but it is always doubtful whether the ulceration is truly tuberculous or whether it represents a tuberculous infection superimposed upon an ordinary gastric ulcer.

Syphilis of the stomach is extremely rare. The symptoms are not distinctive; vomiting and hematemesis are among them. It is contended by some clinicians that there is a more or less definite symptom-complex for the disease. Epigastric pain is the most important symptom and is present in all cases, usually being severe and more intense after meals and at night. In the early stages pain is relieved by food or alkalies, but later on only vomiting gives relief. The vomiting is common and generally occurs after meals. An hour-glass stomach may be a result of syphilis of the stomach, accompanied by the usual symptoms of that condition. Emaciation will be rapid and marked, with anemia, hematemesis, stenosis, general weakness and an active Wassermann reaction.

The diagnosis may be determined with the aid of x-ray and signs of syphilis elsewhere. Where there is ulceration or stenosis present, the condition may occasionally react to antisyphilitic treatment.

Tumors

Benign tumors may occur at any age but, in general, they are rare. *Lipoma*, *myoma*, *fibroma*, *adenoma*, and *lymphadenoma* have been described.

First, they may produce no symptoms; or, if sufficiently large to interfere with gastric function, vague digestive disturbances are complained of. Most benign tumors are located near the pylorus. They are simple or multiple, and either flat or pedunculated. The latter type is capable of producing symptoms of pyloric obstruction when temporarily blocking the pyloric outlet. Hematemesis and melena occur in some benign tumors. It is only in exceptional cases that a benign tumor can be palpated through the abdominal wall. This is most likely to be the case where there is a large, subperitoneal myoma of the stomach, and especially when it is located along the greater curvature.

Malignant Tumors.—*Carcinoma* of the stomach is of such frequent occurrence and its signs and symptoms are so varied that a most analytic study of the condition, as it appears clinically, must be undertaken. The various pathologic types will

not be considered here and we shall devote the discussion only to the clinical phases of the disease. If one looks upon gastric carcinoma, as it exists in its late stages, the picture would, indeed, be very different than the serious consideration of the disease in its incipency, and at a time when successful therapeutics could be employed. In the first place, too much emphasis cannot be used in stating that a *gastric carcinoma may bring forth absolutely no signs or symptoms for a considerable length of time—or if they are present, they may be so trivial as not to attract attention*. It is the early diagnosis which reaps the greatest reward as regards cure, and it is the late diagnosis which offers, at times, only therapeutic palliation—or none at all.

Occurrence.—It is generally considered that the disease occurs especially between the ages of forty and seventy, the mean between the two being the average. On the other hand, the young adult may be affected, though this is of comparative rarity. Statistics show that men are more frequently affected than women, as opposed to the acute gastric ulcer which is more frequent in the female. Too much stress should not be placed upon sex as a factor.

Previous history may be of entirely negative value, the patient suddenly presenting acute or subacute symptoms which call his attention to a stomach condition. This is the *atypical case*, and yet it should be considered as an entity. In the majority of cases, there is possibly a family history of carcinoma, a previous history of ulcer or alcoholism. *In most cases*, gastric symptoms appear within a few months, after which time the severity of the signs and symptoms increase, including “fullness in the stomach,” discomfort after eating and a gradual loss of appetite. This may go on for a fairly long period, until loss of weight, or perhaps the vomiting of blood occurs. Eructations of gas and water brash are common. On the other hand, the mildest type of gastric discomfort and occasional vomiting of mucus without blood may be the first indication of gastric disease. A feeling of fullness and of discomfort may merge into true pain in the epigastrium, with varied abdominal radiation. At times, no pain whatsoever presents unless stenosis is present, in which case it is of the colicky, intermittent type. A dull gnawing or “grumble” is, at times, the only discomfort complained of, and does not occur in paroxysms unless stenosis is present. Without stenosis, *pain* is not relieved at the end of gastric digestion. As a rule, the ingestion of food causes or increases epigastric pain, though this appears usually at a later period than that found in ulcer. There are, however, many instances in which we find no connection between the two. The pain of the stenotic stomach is of more frequent occurrence than it is in the affected curvatures or cardia. Pain, when it does exist, is not relieved by pressure or change of position as is so often the case in ulcer, and though alkalies may have some beneficial influence, certainly in most instances it is not as pronounced as in ulcer.

Vomiting is a variable factor, depending upon the location of the lesion. If the disease is situated in the cardia or curvatures, it is infrequent or not present for a long period of time after the onset of the discomfort; when it does occur, it contains, in about 50 per cent of cases, either occult or microscopic blood. As the disease progresses, vomiting usually increases, and the vomitus is, as a rule, of a “coffee-ground” color. With stenosis, vomiting of large quantities of a “coffee-ground” fluid containing food particles is present to a marked degree. The vomitus

Symptom	Gastric Ulcer (Acute)	Gastric Ulcer (Chronic Indurated)	Duodenal Ulcer
Age and sex	Most common, 20-40. Females more frequently than males.	Most common, 30-50. Males more frequently than females.	Most common, 35-50. Occasionally in newborn. Especially males.
Previous history.	Predisposing factors are poor food, overwork, trades necessitating constant epigastric pressure. Often long-standing history of dyspepsia.	Predisposing factors are similar to those in acute type with long history of intractable indigestion.	Predisposing factors are similar to those of gastric ulcer. Usually found in the robust and perhaps plethoric adult male. Attacks usually in cold seasons. Tendency toward recurrence.
Pain	May be entirely absent. May be preceded or accompanied by a sense of weight, fullness or distention in the epigastric region. "Gnawing and burning sensations" not uncommon. In the majority of cases, pain is often intense, stabbing in mid-epigastrium and referred to the back, right shoulder and occasionally to left arm and shoulder. In some cases the pain is limited to one particular area which patient can readily point out. It appears early after eating (lesser curvature within half an hour, pyloric antrum, one to two hours). It may be relieved by pressure over epigastrium. If ulceration is on posterior gastric wall, relieved by lying in prone position. If on anterior wall, relieved by lying on back. Usually, also relieved by alkalies, gastric lavage and opiates. At times by food.	Usually less sharp than in the acute type, but similar as to region and radiation. Usually appears soon after eating, within an hour or so (lesser curvature); within one or two hours (pyloric antrum). Pain relieved by posture as in the acute type, by pressure over epigastrium, by gastric lavage, alkalies and the taking of food (at times). When stenosis or pyloric spasm is present, the pain often assumes the colicky type.	Usually a dull ache just to the right of midline and radiating to the right posterior scapular region. May be of a more severe type with sense of weight in epigastrium often relieved by vomiting of an acid fluid and eructations of gas. Pain is most intense when stomach is nearly or completely empty, hence the frequency of "hunger pains," two or three hours after eating and often coming on in the late hours of night. The pain appears sooner on liquid diet (often one hour after). Often relieved by alkalies, gastric lavage and opiates; hugging a pillow appears to give comfort to some. Relieved later by food, than in gastric ulcer. There are certain types of cases in which the pain is of a stabbing, sharp and colicky nature, and situated in the epigastrium and right upper quadrant, radiating to right posterior scapular region.
Vomiting of blood	1. Copious, coming on suddenly and shortly ending in death. Very rare. 2. Copious, coming on	More frequent than in duodenal ulcer. Found in the absence of or in marked excess of melena (Moynihan). The	Less frequent than in gastric ulcer. Melena more common than hematemesis. In rare cases vomiting of blood is

OF HEMATEMESIS

Gastric Carcinoma	Esophageal Varix and Cirrhosis of Liver	Symptom
Especially, 40-70. May occur in young adults. Especially males.	35-55. Especially males.	... Age and sex
Occasionally, previous history of gastric ulcer or alcoholism. In most instances, gastric symptoms have appeared within a few months, after which time the severity of signs and symptoms increases.	Early symptoms are usually those of gastro-intestinal disturbances, often in an alcoholic subject. Nausea and vomiting, especially in morning with furred tongue, irregular bowel movements and a sense of heaviness and distention after meals.	Previous history
Feeling of fullness and discomfort in the epigastrium, radiating over varied areas of abdomen. At times, there is no pain, unless stenosis is present, in which case it is of the colicky, intermittent type. A dull "gnawing or grumble" is at times the only discomfort. Does not occur in paroxysms unless there is stenosis, nor is it relieved at the end of gastric digestion. Food increases pain; there may be no relation between the two.	There may be short attacks of localized pain over liver or spleen. There is no relation to the taking of food. Relieved only by sedatives or spontaneously.	 Pain
Without stenosis: At first vomiting of any kind is infrequent, but in about 50 per cent of the cases, vomitus contains either occult or microscopic blood. As disease progresses, vom-	Very profuse and at times quickly fatal. In other cases, hematemesis, fairly profuse, and there may be weeks or months before recurrence. May occur as the initial symptom.	Vomiting of blood

Symptom	Gastric Ulcer (Acute)	Gastric Ulcer (Chronic Indurated)	Duodenal Ulcer
Vomiting of blood (<i>cont.</i>)	suddenly without relation to food, recurrence in few hours or days. 3. Varied amounts, slightly blood-tinged vomitus, with free intervals of weeks or months. 4. Copious, single hemorrhage, sudden onset, no tendency toward recurrence.	reverse is true in duodenal ulcer. Hematemesis may be so copious as to give rise to great alarm, but bleeding usually ceases spontaneously and patient quickly recovers. Intermittent bleeding a prominent feature.	the initial, rather than a late sign. Intermittent hematemesis prominent symptom in this disease, too.
Abdominal examination	Inspection, negative. Degree of rigidity and tenderness varies. There may be but slight tenderness and rigidity in the epigastrium, or it may be marked. One "particular tender point" may be noted.	Inspection is negative unless pyloric stenosis is present, in which case, gastric patterns with waves of peristalsis are observed. A dilated stomach may, in some cases, be seen. Usually slight rigidity and tenderness in midepigastrium; if patient is placed in knee-chest position, epigastric tenderness more pronounced than in duodenal ulcer. Definite, hard and indurated mass often may be felt in pyloric region.	Inspection, negative, unless stenosis present; in which case gastric patterns with peristaltic waves noted. Dilated stomach may be seen. Usually some epigastric tenderness in midline or to the right, combined with local rigidity. Briskness of right epigastric reflex (Moynihan). Tenderness may be very marked and may be slightly to left of midline.
Gastric contents.	Usually microscopic blood and an increase in hydrochloric acid content. Amount of blood may be very small and on frequent examinations may disappear for weeks or months.	In about one-half of cases increase in HCl. Pus alone or with the presence of blood, either microscopic or occult more frequently found than in duodenal ulcer. If stenosis is present, evidences of retention and fermentation.	Ammoniacal gastric fluid may be negative for blood, while feces are usually positive to same test. Entire negativity may be present. Absence of pus in gastric contents and presence of blood or occult blood in stools and often, also, in stomach, points to duodenal ulcer. Blood, if present, usually disappears during rest period of about one week.

HEMATEMESIS (*Continued*)

Gastric Carcinoma	Esophageal Varix and Cirrhosis of Liver	Symptom
iting increases and vomitus becomes of "coffee-ground" color. With stenosis: Vomiting is present to a marked degree and is usually of a "coffee-ground" color. Vomitus is rarely bright red.		Vomiting of blood (<i>cont.</i>)
Inspection, in early stages, negative. Later, fullness or small mass in epigastrium. With stenosis, peristalsis and dilated stomach. In advanced stages, tumor may be very large, with secondary nodular enlargement of liver, giving fullness in right upper abdominal quadrant. Emaciation of abdominal wall may be pronounced. Ascites in late stages. Frequently, enlarged veins. Slight yellowishness of skin. In early stages, there may be no signs or symptoms. In majority of cases, slight definite tenderness noted over epigastrium and recti muscles. In later stages, an irregular mass, in stomach region, or if gastric dilatation is pronounced, mass may appear in lower part of upper right abdominal quadrant or in lower right. Irregularity and hardness of mass or masses an almost constant sign (late stage). When liver is extensively involved it may be large and nodular.	Inspection shows, as a rule, a dilatation of the abdominal veins, radiating from umbilicus (<i>caput medusæ</i>). Often epigastric distention and ascites. In early stages, tenderness over enlarged liver. Later on the liver shrinks and abdomen becomes distended with fluid. Examination of viscera then becomes impossible.	 Abdominal examination
If stenosis is present, evidences of fermentation. Presence of lactic acid. Boas-Oppler bacillus, microorganisms and yeast cells, rarely tumor cells. Absence of free HCl. Usually occult and microscopic blood present. Presence of pus and blood quite persistent.	Normal, except for presence of blood in variable amounts, sometimes absent, at other times profuse hemorrhage.	Gastric contents

DIFFERENTIAL DIAGNOSIS OF

Symptom	Gastric Ulcer (Acute)	Gastric Ulcer (Chronic Indurated)	Duodenal Ulcer
Stools	Temporary melena.	Examination is unsatisfactory unless made persistently over a long period of time. When blood is found, it is intermittent. Test should be made after three days of meat-free diet and ruling out bleeding from mouth, especially gums. Melena less frequent than hematemesis.	Melena more frequent than hematemesis; frequently follows attacks of gastralgia. Disappears during rest periods. Stools may be tarry or bright red.
Special data . . .	When an acute ulcer is strongly suspected, it is unwise to use a stomach tube, in as much as gastric content findings are not of sufficient diagnostic value. Repeated hematemesis leads to severe anemia. X-ray is diagnostic.	X-ray will show lesion. If stenosis is present, patient presents usual signs of pyloric obstruction.	Lesion demonstrated by x-ray. If stenosis is present, usual signs of pyloric obstruction. Appetite usually remains good throughout pain periods. Occasionally jaundice. Duodenal ulcer twice as common as gastric type (Codman).

is rarely bright red, as so often occurs in gastric and duodenal ulcer. The vomiting of large amounts is usually indicative of stenosis. It should be emphasized that in cases of carcinoma of the curvatures and of the cardia, vomiting, though an important symptom, may not be present until the disease has advanced to an inoperable stage. Abdominal inspection in the incipient stages is entirely negative. This negativeness may present throughout the entire course of the disease. As the disease progresses, it is more usual to find a fullness or a small mass in the epigastrium. When pyloric stenosis occurs, a distended or dilated stomach may be visualized, with waves of peristalsis. At times, the tumor may be large, with nodular enlargement of the liver giving a fullness in the right upper abdominal quadrant. Emaciation of the abdominal wall may be pronounced. When occupying the pylorus, the tumor may be seen to move with peristalsis. With liver involvement, ascites, in the very advanced stage, is not uncommon; even a slight yellowness of the skin may be noted.

Abdominal palpation discloses in the early development of the disease, in the vast majority of cases, slight tenderness over the epigastrium with the occurrence of slight rigidity over the recti muscles. There may be no signs or symptoms at this period. In the later stages, an irregular mass is sometimes noted in the stomach region or, if much gastric dilatation is present, the tumor may be in the lower portion of the right upper quadrant. Irregularity and hardness of the masses are almost constant signs (in advanced stages). A well-advanced carcinoma of the stomach, not involving the pylorus, may be present even though the abdominal fat remains plentiful, in which cases no mass may be felt at all. This especially applies to a carcinoma of the posterior gastric wall.

HEMATEMESIS (*Continued*)

Gastric Carcinoma	Esophageal Varix and Cirrhosis of Liver	Symptom
Blood quite regularly found and is persistent during rest period for from seven to ten days. In advanced stages the persistency of melena is noteworthy.	Melena not uncommon. Stools often light colored, unformed. At times profuse diarrhea.	 Stools
Lesion demonstrated by x-ray. Ascites is usually present in the late stages, as is also regional glandular involvement. Metastases may occur to the left cervical nodes. Loss of weight and emaciation.	Jaundice often present. Edema of shins common before ascitic stage (Allbutt and Rolleston).	... Special data

The liver is, as a rule, not palpable unless the case is one of long standing. There are, however, cases which exhibit a large, irregular, nodular, hard liver, with but little stomach involvement, so often wrongly diagnosed as "primary carcinoma of the liver." It is very rare for the spleen to be invaded. When this does occur it is large and irregular. The importance of gastric analysis has been minimized of late years, owing to the progress made in roentgenology in the interpretation of these lesions; to the increased frequency of exploratory laparotomies and to the fact that the findings have been duplicated in other gastric lesions. In the advanced cases of gastric carcinoma the following picture is usually found; absence of free HCl and the presence of lactic acid and the Boas-Oppler bacillus, microorganisms and yeast cells. Usually, occult and microscopic blood is detected and its *occurrence is persistent*; tumor cells may be found. Too much reliance should not be placed upon gastric analysis findings.

The frequent examination of the stools, with the patient under observation and diet, reveals more important data than does the examination of the gastric contents. Blood is quite regularly found and is *persistent during a rest period of from seven to ten days*. In advanced stages the persistency of melena is noteworthy.

Glandular involvement is not of common occurrence (as determined before operation), though the left cervical and left supraclavicular nodes occasionally become affected.

Radiography is of the utmost importance and should be used in all instances of gastric or intestinal lesion suspicion. There are times when the radiograph does not prove the case, but this is not often and should never be the excuse for not employing it.

Carcinoma of the cardia usually gives symptoms of esophageal stenosis though, at times, due to an ulceration of the stomach, bougies may be passed. No tumor is palpable. There may be retardation or absence of the second gurgle, due to swallowing. The supraclavicular glands are often enlarged. All signs of carcinoma may be absent until the disease has far advanced.

Sarcoma of the stomach may be primary or secondary; its onset is gradual and slow emaciation may be the first symptom noted.

The stomach symptoms are the same as in carcinoma; namely, loss of weight, belching, a feeling of pressure and fullness, pain and vomiting, the vomitus assuming a "coffee-ground" aspect. If pyloric obstruction is present all the usual signs of stenosis will be noted, and there may or may not be hematemesis. The condition is a rarity in this location.

The tumor grows in size rapidly, and there is an absence of free hydrochloric acid. Lactic acid is found. *Metastases of the skin are fairly common.* Sarcoma of the stomach should not be considered separately from carcinoma.

Endothelioma.—This is purely a microscopic possibility.

Hour-Glass Stomach

Hour-glass stomach follows syphilis and ulceration of inflammatory processes in the body of the stomach, and may be present in the malignant diseases. The diagnosis is made by means of x-ray, though the signs and symptoms may be similar, in many respects, to disease of one of the curvatures or cardia. An important symptom is the *inability of the patient to eat more than a small amount of food, which is soon vomited.* In a patient under our observation at the present time, and with this condition, this symptom is greatly benefited by his sitting straight up in bed. This posture apparently allows of an easier passage of food through the stricture.

ETIOLOGY OF HEMATEMESIS

Stomach	{	trauma	{	from without (blows, etc.)	{	bones, needles, etc.									
		ulcerations		from within (injuries to mucous membranes)		stomach tube damage									
	{	tumors and	{	benign and malignant	{	mineral acids or caustic alkalies									
		ulcerations		superficial ulcers, streptococcus infections (Rosenow, <i>J. Am. M. Ass.</i> , 1915, 65: 1687-1691)		poisons (antimony, arsenic, etc.)									
	{														
							acute dilatation								
							chronic gastritis								
							syphilis								
							tuberculosis								
							gastro-ataxia (male white)								
following burns (body)															
Duodenum	{														
	{														
	{														

- Diseases of bile and liver tracts {
 cirrhosis
 tumors
 compression on vena cava (whatever source)
 pylephlebitis
 cyanotic liver (congested)
 acute yellow atrophy
 gall-stones ulcerating into stomach or duodenum
 cholelithiasis and chronic cholecystitis (about 2 to 4 per cent)
- Diseases of blood-vessels {
 thrombosis
 embolism
 aneurysm
 varicosities
 atheroma
 fatty degeneration
- Diseases of heart and lungs (especially valvular lesion)
- Blood, spleen and liver dyscrasias {
 hemophilia
 purpura
 leukemia
 pernicious anemia
 scurvy
 Hodgkin's disease
 Banti's disease
 splenic anemia
 chloroma
- Diseases of pancreas {
 acute pancreatitis
 pancreatic duodenal fistula
- Acute infectious diseases {
 scarlet fever
 yellow fever
 smallpox
 pneumonia
 typhoid fever
 diphtheria
 cholera
 typhus
 malaria
 measles
 dengue
- Neuropathic {hysteria
- Menstrual type {
 with amenorrhea
 vicarious, at menstrual periods
- Diseases of esophagus {
 varicosities
 ulcerations
 tumors (especially malignant)
- Postoperative {
 acute jaundice
 erosions
 embolism or thrombosis (especially after appendectomy or gastro-enterostomy)
- Diseases or injuries of nose or mouth
- Mediastinal growth (ulcerating)
- Weil's disease
- Intestinal obstruction, intussusception and growths of upper small intestine (very rare)
- Fallopian tube infection (Deaver, *Surg., Gynec. & Obst.*, 1914, 18: 294-299)

AFFECTIONS OF THE SMALL INTESTINE

Foreign bodies { enteroliths
gall-stones
fruit pits
masses of hair
other objects which have been swallowed

inflammatory conditions { acute
chronic

Duodenal ulcer (See chart "Differential Diagnosis of Hematemesis.")

Intussusception (See chapter XXI, "Intestinal Obstruction.")

Enteroptosis

Perforating typhoid ulcer

Granulomata { tuberculosis
syphilis
actinomycosis

Diverticulitis (Meckel's)

Old chronic inflammatory conditions

Hemorrhagic infarctions or "gangrene of gut"

Tumors { benign { adenoma
papilloma
polyp
lipoma
fibroma
lymphoma
myxoma
osteoma
hemangioma
myoma
teratoma
chylangioma
enterocystoma
mixed forms
malignant { sarcoma
malignant lymphoma
endothelioma
carcinoma

Foreign Bodies

The most frequent sites for foreign bodies are in the lower portion of the ilium and in the cecum, though any part of the alimentary tract may lodge one. Their presence is important from the standpoints of intestinal ulceration and obstruction, the latter condition being caused directly by the foreign body, or as a cicatricial contraction, the result of ulceration; rarely, one has to consider the possibility of perforation.

Enteroliths (*fecal concretions*) are of fairly frequent occurrence and usually represent fecal salt deposits, about some foreign body, such as a fruit pit, balls of hair, etc. At times, a gall-stone or food residues will be the nucleus.

Gall-stones represent a fair proportion of the foreign bodies causing symptoms and, at times, give rise to the most stormy signs of an intestinal obstruction, both of the acute and chronic type. It has been estimated that about three-quarters of these cases occur in women. The stone, if sufficiently large to give rise to obstructive symptoms, being too large to pass the common duct, must of necessity perforate through the gall-bladder; it then may perforate into the bowel, especially in the lower portion of the ilium. At times, the stone may be situated high up in the intestine. According to Mayo Robson all cases of obstruction due to gall-stones are not the result of mechanical obstruction but there are three other possible causes:

1. Local peritonitis in the gall-bladder region causing paralysis of the bowel.
2. Volvulus of the small intestine due to biliary colic or to ulceration of the intestine by a gall-stone.
3. Obstruction coming on after the original cause has disappeared and, due to adhesions, without obstruction within the gut. For symptoms of obstruction see chapter on "Intestinal Obstruction."

Inflammatory Conditions

Acute enteritis is an inflammatory condition of the intestinal tract which may be confined to any portion, but more commonly affects either the entire small or large intestine. It is important to differentiate the condition from acute appendicitis or other intra-abdominal infections. It may be present at any age, and is more serious in infants or elderly people. Many cases cannot be attributed to a specific cause but a careful history will usually reveal some indiscretion in diet, such as too much food or an improperly prepared article. Chemical or mechanical irritants may be responsible. The condition occurs frequently in acute infections anywhere in the body. The attack usually begins with a sense of fullness in the lower abdomen, followed by colicky pains and diarrhea. The pains are diffuse or girdle-like across the abdomen; tenderness accompanies the pain. As a rule there is no temperature and no leukocytosis. There are numerous stools. The first few contain fecal material, but they soon become semifluid and liquid. Diarrhea is more marked, if the large intestine is involved. In some cases the odor is very offensive, especially after errors in diet. The color may be dark at first, changing to light yellow and even becoming greenish. Mucus may be present in large amounts; the larger the amount, the lower the point of involvement of the intestinal tract. The abdomen is often moderately distended with gas and gurgling sounds may be heard on motion or palpation. In a healthy person recovery is the rule in from three to five days, but this depends on the etiology. The attack may become chronic or be followed by a severe constipation.

Chronic enteritis is an inflammation of the intestinal tract characterized by functional disturbances of the bowels over a long period. Most cases follow the acute type, which has not been cured or has been repeated several times; the etiology, therefore, is the same as for acute enteritis. Other cases are secondary to chronic diseases of almost any organ, especially tuberculosis, diabetes, viscerotaxis, or from pressure of tumors on the intestines or colon. Symptoms are absent in many cases, but most patients complain of very mild symptoms of acute enteritis. There

may be a feeling of distress in the lower abdomen, especially just before defecation, or in the early morning. Flatulence may be marked and very distressing to the patient; belching or passage of gas per rectum gives relief. Mild pains are often present across the lower abdomen. The patient may feel weak and tired out, have severe headaches and nausea, lose weight and become anemic. The characteristic finding in the stools is *mucus* which may be intimately mixed with the fecal material, surrounding the particles, or occur separately. Blood may be found. The lower the portion of the intestinal tract involved, the greater will be the amount of mucus, but less completely mixed with the feces.

Enteroptosis

The small intestine sags with its mesentery, either alone or in conjunction with abnormal mobility of other abdominal viscera (Glenard's disease). This condition, known as enteroptosis, is found especially in women of a neurotic temperament. Many are underweight and poorly developed, their posture often being stoop shouldered or otherwise faulty. Various gastric symptoms of a minor nature, vague abdominal pains, and headache are usually complained of. Upon examination the faulty posture is recognized and the lower portion of the abdomen is pendulous when standing. One or both kidneys may be palpated. Bismuth intestinal series will show a general sagging of the small intestine, in which the stomach and colon are often involved.

Perforating Typhoid Ulcer

Of all the acute abdominal conditions of surgery there is none which is of more moment to the surgeon or physician than the above affection; the physician should realize the absolute necessity of making a prompt and efficient diagnosis, and it is only for the surgeon to employ a little mechanical skill and good judgment in the subsequent handling of the case. How significant are the sharp, knifelike pains which come on suddenly in the patient who is in apparent comfort; how to be dreaded is the sudden fall of temperature with a gradual rising of the pulse rate and finally how discouraging to a surgeon is the ballooned abdomen, the sensitive and tense belly; the countenance of impending death!

It is, therefore, imperative for all to understand the condition, to interpret the symptoms, and to act with our best judgment in the conduct of the case. The chief factors which must be considered are:

1. At what age is it most common?
2. At what stage of the disease is it most frequent?
3. Is one sex more prone to the disease than the other?
4. The significance of the pain.
5. Significance of the temperature and pulse.
6. The condition of the belly wall on inspection, palpation and percussion.
7. The type of abdominal breathing.
8. The general appearance of the patient.
9. Shock.
10. The white-cell count.

Age.—This complication is most common between twenty and thirty years, but it may occur in childhood or later adult life.

Stage of Disease.—Most frequently found between the third and fourth weeks of the fever, but it may occur after the subsidence of the fever and when all apparent intestinal symptoms have disappeared. Ambulatory cases of typhoid fever may show signs of perforation as the first warning of the disease.

Sex.—About three times as common in the male.

Pain.—Perforation is always accompanied by sharp sudden pain over the entire abdomen, perhaps starting in the epigastrium, right iliac fossa or the pelvic region. The pain is intense and it is not uncommon for the patient to scream out when the condition presents. Great importance should be attributed to this symptom, especially if other signs immediately follow.

Temperature and Pulse Rate.—Accompanying, or soon after the onset of the pain, the temperature usually drops some degrees, often to subnormal, and there is a gradual rise in the pulse rate. As peritonitis develops, and if the patient responds well from the shock, a gradual rise will follow.

Examination of the Abdomen.—At first, the abdomen may appear normal on inspection with the possible exception of retarded abdominal breathing movements. There usually follows, within a few hours, a symmetric distention with an absence of practically all abdominal movements. The abdominal muscles become rigid and boardlike, and tenderness is elicited over the entire abdomen, usually most pronounced in the right iliac fossa. There soon follows an extensive tympanites with a loss of hepatic dulness. As the peritonitis advances, free fluid may be detected in the flanks.

Type of Breathing.—The abdominal movements become less and less marked until we have an almost complete thoracic breathing.

Appearance of Patient.—The patient becomes restless, tossing about in bed, perhaps holding his hand or hands over the sensitive abdomen; the face becomes anxious and pinched as the condition progresses; stupor or delirium may usher in the signs of impending death, from a general peritonitis and toxemia.

Symptoms of shock are always present to a marked degree, usually quite immediate, often delayed for but a short period. The pulse becomes rapid, of low tension and it is flabby, often existing with but a barely perceptible beat for many hours. As the peritonitic reaction comes on, there may occur a temporary improvement in the pulse which may become stronger though not improving in its rate. The patient himself may show evidence of more strength for a time, the toxemia of the peritonitis acting as a temporary stimulant. As a rule, this reaction is for but a short space of time.

The **white-cell count** in this type of case may advance somewhat from a pre-existing leukopenia; the increase of the cells depending upon the virulence of the secondary infection. An increase in the cell count should always be considered as a factor in the diagnosis, but negative findings should not rule out the possibility of perforation. It should be remembered that the increase in the count is proportionate to the length of time elapsing between the perforation and the blood examination.

Other symptoms which may occur are tinges of blood in the stools, and perhaps pain on urination and defecation. Nausea and vomiting may be present.

Granulomata

Tuberculosis.—This condition in some forms unquestionably often exists over a considerable period of time without giving the patient sufficient symptoms to even warrant consulting a physician; this is proven by the findings either during a surgical procedure for some other condition, or in the postmortem room. Indeed, the frequency of the finding of healed tuberculous conditions of the lungs, though more common than the finding of healed tuberculous conditions of the peritoneum and intestine, causes one to feel that, after all, tuberculosis of the peritoneum or intestine, or both, is a more common disease than heretofore recognized.

Tuberculosis of the small intestine may be primary or secondary. The primary condition is caused by the ingestion of some foodstuff contaminated with the tubercle bacillus; secondary tuberculosis of the intestine is often due to the swallowing of tubercle bacilli contained in the sputum of one suffering with pulmonary or laryngeal tuberculosis; perhaps from primary tuberculosis of the mesenteric lymph glands, from tuberculosis of the peritoneum or other tuberculous affections of the body.

The lower portion of the ileum and the cecum are the most frequent sites of involvement, though in the diffuse form, part or all of the small gut may be diseased.

Two main groups are to be considered: (1) Diffuse, and (2) ileocecal.

The diffuse form is characterized by disseminated tuberculous ulcerations of the intestine and most frequently accompanies an extensive pulmonary tuberculosis. The symptoms, as a rule, are stubborn to treatment, inasmuch as there is no disposition on the part of the ulcers to heal. A severe and, at times, uncontrollable diarrhea, blood and tubercle bacilli in the stools, with emaciation and loss of weight, together with some tuberculous focus, especially of the lungs or larynx, confirm the diagnosis. This form of the disease is fatal, and so often represents the termination of a tuberculosis of the lungs. *Ileocecal* tuberculosis, on account of its varied pathology and clinical differences, too, is subdivided into the ulcerative and hyperplastic forms.

In the ulcerative form we have, as a rule, multiple, though occasionally solitary, tuberculous ulcers, often with abscess formation, in the lower ileum or in conjunction with the cecum. The ulcers in this group have more of a tendency to heal, and form cicatrized areas which often lead to an intestinal obstruction. The diagnosis is not easy, especially if complete obstruction has not occurred, and is based upon: The age of the patient (usually between twenty and thirty years); the intermittent colicky pains with the transitory diarrhea and then extreme constipation; the bleeding from the bowels and the possible finding of tubercle bacilli in the stools; signs of tuberculosis elsewhere in the body; the thickening of the gut about the cecal region; the active peristalsis; the progressing emaciation.

The hyperplastic form, which emanates from the peritoneum or mucosa, is characterized by more progressive symptoms of obstruction, plus the presence of a fairly fixed, irregular mass about the cecal region.

Tuberculosis of the Cecum.—See chapter on “Affections of Appendix and Cecum.”

Syphilis is an extremely rare condition, but is known to have occurred in the

small intestine, as well as in other parts of the gastro-enteric tract. In a case suffering with symptoms of partial or complete obstruction, with the presence of a positive syphilitic history and Wassermann reaction, we may consider the possibility of a diagnosis.

Actinomycosis.—Much has been written about actinomycosis of the cecum and ileocecal regions, but on going over a differential diagnosis we find that the symptoms are much like those of the ileocecal hyperplastic form of tuberculosis; the exceptions being that tubercle bacilli are not found in the stools, and that abdominal wall sinuses and the ray-fungus are commonly found in actinomycosis. It is most frequently found in farmers.

Tumors

Benign.—Adenomata, myomata, papillomata and polyps and lipomata appear as definite clinical entities; the other benign tumors of the small intestines are really clinical and pathologic curiosities. The occurrence of any of the above is infrequent, and their presence is usually discovered as an accident in the course of operative or postmortem examination. Their surgical importance lies in their tendency:

1. To undergo malignant changes. This is especially so with the adenomata, which exhibit a great tendency toward carcinomatous degeneration.

2. To grow to such a size as to occlude the gut lumen, causing partial or complete intestinal obstruction. Of all the benign intestinal tumors the myomata are the most likely to show this characteristic. See "Intestinal Obstruction."

3. To aid in the formation of an intussusception. This especially refers to the adenomata and myomata. See "Intestinal Obstruction."

Malignant.—Malignant tumors of the small intestine occur at any period of life, from infancy to old age. This is true of all varieties of malignancy. *Sarcoma* is more common in the small intestine than it is in the large intestine; while *carcinoma* more frequently attacks the large bowel. Sarcoma occurs in the ileum, chiefly, while carcinoma arises principally in the duodenum and terminal ileum. *Lymphoblastoma*, which is clinically and pathologically allied with sarcoma, and which frequently cannot be differentiated from the latter, develops in any part of the small intestine. In general, sarcomata are more rapid and invasive, while carcinomata are of comparatively slower growth and usually more localized, with a tendency toward annular distribution. Regional glandular involvement, hepatic and pulmonary metastases take place in both affections.

The onset is slow and insidious. A feeling of fullness, of moderate distress sometimes after the ingestion of food, is one of the earliest symptoms. The nearer to the pylorus, the more exaggerated and the more rapid is the development of symptoms. Various types of "indigestion," perhaps nausea and vomiting and increasing constipation ensue. Pain is a relatively late symptom, is colicky in type and is located in the upper or central abdomen. At times, there is bleeding—either hematemesis or dark, tarry blood in the stools. The initial indications may be altogether vague, and an acute intestinal obstruction or acute perforative peritonitis may be the first evidence of the underlying condition. In late stages with peritoneal or hepatic involvement, there are often signs of free intraperitoneal fluid.

Upon examination, in addition to the signs of loss of weight and strength, and perhaps pallor, the contour of the abdomen may be found altered. This may be due to distention, free fluid, a large tumor mass or intestinal "mounds." The central portion of the abdomen, or the upper abdomen alone, depending upon the site of malignancy, will frequently be found prominent and tympanitic, while the flanks remain flat. Peristaltic waves should be carefully sought for. A palpable tumor in the very early stages will be movable, but it is usually noted in moderate or absolute fixation. Intestinal gurglings and patterns are important signs, as is shifting dullness. Glandular masses may be noted apart from the original tumor. Rectal examination should always be made as, in some cases, information of value can only be obtained in this manner. Radiography is of great importance but has its limitations. The subsequent course of intestinal malignancies is obvious.

The *lymphoblastic tumors* occur singly or are multiple, and arise mostly in young adults. The clinical course is the same as that found in sarcoma. The liver and spleen may be enlarged, and retroperitoneal glandular masses are common.

AFFECTIONS OF THE GASTRO-INTESTINAL TRACT

Congenital malformation	{			transposition
	{			stricture and stenosis
	{			pyloric stenosis
	{			Meckel's diverticulum
Injuries	{			
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Foreign bodies	{	those swallowed gall-stones enteroliths
Tumors	{	benign { papilloma adenoma myoma lipoma polypus myxoma fibroma lymphoma osteoma hemangioma melanoma teratoma chylangioma enterocystoma mixed forms malignant { sarcoma malignant lymphoma carcinoma endothelioma
Ptosis	{	gastroptosis enteroptosis (Glenard's disease)
Granulomata	{	tuberculosis { appendix cecum syphilis actinomycosis
Acute dilatation of stomach		
Intussusception		
Idiopathic dilatation of colon (Hirschsprung's disease)		
Cysts—retention cysts of appendix		
Obstruction	{	adhesions { inflammatory postoperative tuberculous foreign bodies and concretions congenital bands and cecal formations intussusception strangulation of diverticulum strangulated hernia, external or internal tumors, benign or malignant volvulus
Dysentery	{	amebic bacillary
Hemorrhagic infarctions or "gangrene of gut"		

CHAPTER XIX

THE APPENDIX AND CECUM

AFFECTIONS OF THE APPENDIX

Inflammatory conditions	{	acute	{	catarrhal	{	with abscess
						with localized peritonitis
						with pelvic peritonitis
						with general peritonitis
				gangrenous		
		subacute				
		chronic				
Granulomata	{	tuberculosis				
		actinomycosis				
Cysts	{	retention				
Tumors	{	benign	{	fibroma		
				myxoma		
				polyp		
				myoma		
				lipoma		
		malignant	{	sarcoma		
				carcinoma		
Complications						

History

Age

Family History.—Tuberculosis, cancer and other tumors, appendicitis, “inflammation of bowels,” intestinal disturbances.

Personal History.—Acute infectious diseases, constipation and indigestion; habit of bladder. Attacks similar to present illness.

Present Illness.—Onset, acute or gradual. History of dietetic indiscretion. Pain, character and radiation of same, and has pain become localized in any particular area? Nausea, vomiting, hiccough, time of last bowel movement. Has urination been more frequent since onset of present illness and is pain or “burning sensation” present on urination? Pain on defecation.

Physical Examination.—General appearance of patient, including facies, position of knees, type of breathing (thoracic or abdominal), condition of skin as regards color and moisture; shape and general inspection of the abdomen, point of maximum tenderness; deep or superficial rigidity, or both; mass on palpation. Is mass felt on rectal examination and is pain felt during that procedure? Condition of abdomen at McBurney’s point. Pulse and temperature; leukocytic and differential count.

INTERPRETATION OF HISTORY

Age

Childhood and Early Adult Life {acute appendicitis

Early Adult and Adult Life {chronic appendicitis
carcinoma of appendix
acute appendicitis
tuberculosis of appendix

Middle Age {acute and chronic appendicitis
actinomycosis and carcinoma

It is important to remember that no age is exempt from the inflammatory conditions.

Present Illness.—*Onset.*—Practically all cases of acute appendicitis have a sudden onset, though an acute onset often occurs as an exacerbation of a grumbling, possibly chronic appendicitis.

In children, minor symptoms often usher in an acute attack. The slow and insidious onset of a chronic appendicitis is well known.

Dietetic indiscretion often precedes many attacks and, at times, is misleading. How often does the surgeon observe the relationship between the “eating of peanuts, ice cream, etc.,” and an acute attack?

Pain.—The pain of an acute appendicitis is more or less variable, depending upon the location of the appendix and the severity of the disease. A severe or moderately severe pain diffused over the abdomen, especially in the epigastrium, and radiating to the iliac fossa, is of frequent occurrence. On the other hand, a sharp, shooting pain directly over the appendix region and radiating to the epigastrium and entire abdomen is equally common.

Occasionally we find only localized pain. In cases of acute retrocecal appendicitis, the pain, sharp in character, may be referred to the right lumbar region or right upper abdominal quadrant. Appendices situated in the pelvis often give rise to the most severe pain, referred to the pubic region and right lower abdominal quadrant. The pain may be constant or intermittent.

Nausea and vomiting are usually present, often ushering in an acute attack. The vomiting is, as a rule, repeated as the infection spreads. Occasionally, only nausea is present.

Hiccough is often present when the diaphragm has become involved in the inflammatory process, or where dense adhesions are present. It is a symptom which should always be considered as of unfavorable import, especially when it appears as a complication.

Time of last bowel movement should be considered from the standpoint of differentiation, knowing as we do that an impacted cecum may often give rise to important and prominent appendical region symptoms.

Frequent urination often indicates the presence of an inflammatory condition of a pelvic appendicitis, with perhaps secondary pericystitis.

Pain on Defecation.—If this symptom is present, a pelvic abscess may be considered.

Physical Examination.—*Point of Maximum Tenderness.*—The classical area of maximum tenderness is over McBurney's point, which is the midpoint of a line drawn from the umbilicus to the anterior superior spine. Munro's point, which

is theoretically directly over the ileocecal valve, instead of being midway in the line drawn from the umbilicus to the anterior superior spine, is at the outer edge of the rectus. Tenderness at this point is considered of diagnostic value. The above two points are the textbook index of maximum tenderness, yet many variations are observed, depending upon the exact position of the appendix and the extent of the infection, and too much stress should not be laid upon the classical points. In a series of cases, however, McBurney's point is probably the most common site.

The general appearance of the patient may be of absolutely no value, but in the more severe infections and where we have an extensive peritonitis with marked toxemia, there is evident prostration with a perhaps pinched face, cyanotic mucous membranes, rapid breathing (usually entirely thoracic), and a pallor or flushing. Flexed knees often indicate an extensive peritoneal irritation. The hand of the patient is often held over the point of maximum pain.

Leukocytosis is a most dependable symptom, though at times it may be misleading.

An early acute appendicitis may show little or no increase in the white cells; as the inflammatory process advances, the white cells increase in proportion, but an extremely high count is often indicative of a possible coexisting intestinal derangement, either independent of or as an accompaniment of an acute appendicitis. An hyperleukocytosis is, of course, often present in abscess formation or when the organism is of an extremely virulent nature.

Inspection of the abdomen may or may not be of value. Negative findings do not rule out acute and severe inflammatory conditions, but where we have a marked distention with restriction of abdominal breathing, extensive infection is suggested. Intestinal atony with its accompanying distention is of symptomatic occurrence in an extensive infection. Less often, we may find definite peristaltic waves due to mechanical obstruction, secondary to infection. An asymmetrical abdomen often denotes the presence of an abscess.

Rigidity.—Of all important symptoms rigidity is the most dependable, and it is quite safe to say that it is present superficially, deeply, or both, in practically all cases of acute appendicitis; the site of rigidity depends upon the location of the appendix and the extent of the infection.

Regardless of the site of maximum pain, it may be considered that a certain amount of rigidity is practically always present over McBurney's point. This, at times, may only be obtained on very deep palpation.

A mass on palpation may indicate a large, inflamed appendix, an inflamed appendix with localized peritonitis, an appendix enwrapped with omentum, a partial intestinal obstruction from adhesions, or an abscess.

Rectal examination may be entirely negative; on the other hand, a mass found, or tenderness elicited, usually indicates a pelvic appendicitis with perhaps an accompanying abscess.

Inflammatory Conditions

Acute Appendicitis.—In all acute abdominal conditions, it is worthy of note that some inflammatory condition of the appendix should be foremost in the examiner's mind, in as much as the disease is so commonly found and its symptoms are so variable.

It is therefore necessary that one should investigate, through accurate history taking, the course and symptoms of the condition as presented by the patient, always bearing in mind the possible involvement of the appendix. With this end in view, questioning in regard to a family history of appendicitis and "inflammation of the bowels" is of importance, knowing as we do that there is a tendency toward the occurrence of inflammatory conditions of the appendix in successive generations; "inflammation of the bowels" in former years having been the term often misapplied to an acute appendicitis. The history of acute infectious diseases, constipation and indigestion, and previous similar attacks, is so frequent that they must be considered as important factors in the diagnosis.

For signs and symptoms see "Interpretation of History."

Complications

Abscess

Pylephlebitis

Intestinal obstructions (dynamic and adynamic)

Thrombophlebitis

Intra-abdominal hemorrhage

General peritonitis

Subphrenic abscess

Acute Appendicitis in Children.—Acute appendicitis in children is most common between the ages of ten and fifteen years. It is rare in infancy, while a fair number of cases occur in the intervening period. Males are more often affected than females. Foreign bodies which have been ingested by the child are infrequent causes of the disease, while pin-worms are said to precipitate many attacks.

Many cases, both subjectively and objectively, resemble the attack as seen in the adult person; the onset, in the majority of cases, is somewhat irregular, especially in younger children. Pain, which is such a prominent symptom in the adult, very often is not localized by the young patient and, in fact, is commonly indefinite. Vomiting, usually persistent, is the most constant symptom, both at the onset and during the course of the attack. In regard to the bowels, constipation is the usual accompaniment of acute appendicitis, but diarrhea is not uncommon, accounting for the confusion in diagnosis between gastro-enteritis and appendicitis.

Fever and leukocytosis are usually present and the former is, as a rule, higher than in adults. Because of apprehension, true tenderness may only be elicited with difficulty. Rigidity of the abdominal wall musculature is the most reliable sign, and when found in the right lower quadrant, or over the entire abdomen, with apparent exaggeration and tenderness in the right iliac fossa, and associated with gastro-intestinal symptoms, acute appendicitis should be the probable diagnosis.

Too much reliance should not be placed on the temperature, as many cases of acute appendicitis, even of the gangrenous type, occur in children without fever, the diagnosis being founded altogether on the local physical signs. It is also advisable to regard any case of supposed appendicitis in which the temperature is overhigh as being, in all probability, of some other origin.

DIFFERENTIAL DIAGNOSIS OF ACUTE APPENDICITIS

1. Acute gastro-intestinal disturbance
2. Acute cholecystitis
3. Cholelithiasis
4. Typhoid fever
5. Pneumonia and diaphragmatic pleurisy
6. Renal and ureteral colic
7. Pyo- and hydro-nephrosis
8. Intussusception
9. Acute pancreatitis
10. Inflammation of Meckel's diverticulum
11. Twisted pedicle of uterine and ovarian tumors
12. Internal strangulation of hernia
13. Acute inflammation of tubes and ovaries
14. Extra-uterine pregnancy
15. Tuberculous peritonitis
16. Acute arthritis
17. Lead colic
18. Impacted cecum
19. Embolism and thrombosis of mesenteric vessels
20. Intestinal obstruction
21. Perforation of gastric or duodenal ulcer
22. Hysteria
23. Acute exanthemata

1. *Acute gastro-intestinal disturbance* usually follows some dietary indiscretion, and is generally ushered in with severe colicky pains which may be diffused throughout the abdomen or localized in the epigastrium. Patients may vomit, but the rule is a feeling of desire to vomit. If the patient is given a good emetic and enema, the symptoms generally disappear, though severe intestinal disturbance may not clear up until the patient has been given a good cathartic. The temperature and pulse usually remain normal. There is no localized tenderness or rigidity over McBurney's point.

2. *Acute Cholecystitis*.—It is occasionally impossible to differentiate this condition from an acute appendicitis. Pain is most common over the gall-bladder area with radiation to the right shoulder. High temperature and usually chills are present. There is often a history of typhoid fever or former gall-bladder attacks. Tenderness and rigidity over Robson's point are marked. Perhaps jaundice will be noted; often there is a mass under the liver. Muscular rigidity is usually marked over the right upper quadrant, right loin and epigastrium. Bile index in blood may be high. Urine often contains bile.

3. *Cholelithiasis* often presents the same symptoms as found in acute cholecystitis. Jaundice may be more pronounced, especially if stones are in one of the ducts. Usually there is no fever or rise in pulse rate. There may be slight constitutional disturbance, and a previous history of passage of gall-stones by the rectum. Jaundice, however, may be entirely absent. See "Affections of the Liver. etc."

4. *Typhoid Fever*.—There is generally present a leukopenia. Pain and rigidity will be in right iliac region, not marked and often entirely absent. Other symptoms of typhoid may be present. Diarrhea is usually pronounced in the first few days, though constipation may be present. The Widal reaction is present if the disease has progressed for a week. We must remember that the appendix may become acutely inflamed in the course of typhoid fever.

5. *Pneumonia and diaphragmatic pleurisy* give abdominal symptoms, especially in children. In pneumonia, there will be a history of chill and sudden high rise in temperature, with very high leukocytosis, and increased respiration. The pain is seldom localized and the rigidity is more diffuse. Thoracic examination will, as a rule, detect the condition. Respirations are shallow and rapid, and pain is present on breathing. Cutaneous hyperesthesia is often present.

6. *Renal and ureteral colic* show little abdominal tenderness, or rigidity on deep palpation. There is often present the history of the previous passing of renal sand; the appearance of red and white cells and crystals in urine is quite constant. May be diagnostically aided by radiography and cystoscopy. There will be lumbar pain extending down course of ureter into the groin and genitals. A sudden cessation of pain is common in renal colic, after the passing of large amount of urine.

7. *Pyo- and hydro-nephrosis* exhibit many of the symptoms that are present in acute appendicitis, though in the above more pus is found in the urine. Chills and fever usually occur.

8. *Intussusception* is usually found in children. There will be the presence of a sausage-like mass in the abdomen and blood in stools; perhaps definite intestinal obstruction symptoms.

9. *Acute pancreatitis* presents with sudden severe pain in epigastrium accompanied by extreme shock and prostration. Great tenderness and muscular rigidity are noted over epigastrium. Collapse is speedy. There may be fat in the stools. Repeated vomiting is practically always present.

10. *Inflammation of Meckel's Diverticulum*.—It is practically impossible to differentiate this condition from acute appendicitis.

11. *Twisted Pedicle of Uterine and Ovarian Tumors*.—If tumor is small it is often impossible to differentiate. Vaginal, or even abdominal examination may elicit tumor. Tenderness and rigidity are usually low down in right lower quadrant. As a rule, there is more general abdominal rigidity and tenderness.

12. *Internal Strangulation of Hernia*.—Ascertain history of former hernia. Examine inguinal and femoral rings. Usually early signs of obstruction are obtained.

13. *Acute Inflammation of Tubes and Ovaries*.—Social position of patient, also general appearance, must be considered. Ascertain history of vaginal discharge or uterine manipulation. Tenderness and rigidity are usually lower down than McBurney's region. There may be slight tenderness over McBurney's region. Vaginal examination elicits pain. Perhaps a mass of adhesions of the adnexa to uterus will be found. Nausea and vomiting are infrequent.

14. *Extra-uterine Pregnancy*.—Mass in pelvis. Note color of patient, signs of pregnancy, bleeding from uterus. There will perhaps be fluid in abdominal cavity, and marked leukocytosis; unless secondary infection has occurred, the tem-

perature is normal or only slightly elevated. Often the temperature is subnormal. Signs of hemorrhage are usually present.

15. *Tuberculous peritonitis* shows less acute abdominal tenderness and rigidity; no definite localization of symptoms. Heredity. Pulmonary examination. There is no leukocytosis. Rise in mononuclear cells is noted. Temperature may be somewhat elevated at night. Often there is free fluid in the abdominal cavity.

16. *Acute Arthritis*.—There is gradual flexion of thigh. Pain and mass of a lumbar abscess may resemble, especially in children, an acute appendicitis. Diagnosis should be made by deformity, x-ray, lack of intestinal and gastric symptoms and small amount, if any, of tenderness over McBurney's point.

17. *Lead Colic*.—Take careful history of patient. Examination of blood will confirm diagnosis. Lead line on gums.

18. *Impacted cecum* gives symptoms which are usually not so severe, and enemas give marked relief.

19. *Embolism and thrombosis of mesenteric vessels* occur usually after middle age, but it is impossible to differentiate the condition.

20. *Intestinal Obstruction*.—There is the presence of peristalsis, great bulging of bowel. Former history of marked constipation, and passage of ribbon-shaped stools. Peristalsis and patterns may be present.

21. *Perforation of gastric or duodenal ulcer* usually comes on with sudden and excruciating pain, followed very soon by great shock. Blood may be present in the vomitus or stools. Pain is nearly always referred to the epigastrium or umbilicus. Young women are prone to gastric ulcer. History.

22. *Hysteria*.—The great point in the differential diagnosis is the disappearance of rigidity over the appendix when the patient's attention is diverted. No fever and no leukocytosis.

23. *Acute Exanthemata*.—In the course of the acute exanthemata, such as measles and scarlet fever, a general inflammation of the peritoneum may simulate a case of appendicitis. In these cases the pain and rigidity is more general, and there is no particular increase of sensitiveness and rigidity over the appendix region. Rash. Possible sore-throat.

Subacute Appendicitis.—Clinically, these cases should be considered as mild acute exacerbations of preëxisting chronic inflammatory conditions of the appendix. The train of symptoms follows that of a mild acute attack.

Chronic Appendicitis.—Of all chronic diseases of the abdomen, cases of chronic appendicitis have, for the past decade, occupied the most prominent position. The symptoms caused by this condition are so variable and give rise to such diverse complaints that it is impossible to classify them on the basis of a "symptom-complex." Many cases are frank in their manifestations; others are so veiled in a tangle of referred symptoms that, at times, diagnosis can only be arrived at by the exclusion of simulated conditions. Indeed, there are times when we arrive at a diagnosis of chronic appendicitis too abruptly, and without the proper consideration of other affections present. Cases which present recurrent attacks of pain in the right lower quadrant, accompanied by digestive disturbances, including constipation and increased soreness on the right side, especially during activities, should be suggestive. A "constant tugging" with a sense of uneasiness at all times is often the only subjective symptom. Localized pain in the right

lower quadrant, with constipation, are the two most important subjective factors. If, on the other hand, a more or less diffuse soreness is noted by the patient over a fair portion of the abdomen, referred to the right lower quadrant, we should at least consider the possibility of existing adhesions about the appendix and cecum. Added to the above, and almost constantly occurring, is the presence of at least a certain amount of muscular rigidity in the appendix region.

There is a certain class of cases in which the gastric symptoms are the most predominant, including eructations, slight distress after eating, and, most important of all, a "feeling of heaviness" in the epigastrium; the true nature of which is revealed by abdominal palpation, which brings to light physical signs over the appendical region.

Granulomata

Tuberculosis.—It is difficult to consider tuberculosis, in itself, as a clinical entity; cases are on record in which there seems to be, pathologically, a primary tuberculous infection within the appendix. More commonly, tuberculosis of the appendix is secondary, either to cecal tuberculosis or to a tuberculosis of an organ elsewhere in the body, such as the lungs. There are recognized two forms of tuberculosis of the appendix: (1) Ulcerative or caseous type; and (2) hyperplastic type.

The former is usually associated with a generalized tuberculosis of the intestinal tract, while the latter is usually limited to the cecal region. From the standpoint of diagnosis, it is quite impossible to draw a clinical conclusion though, with a patient who exhibits symptoms of chronic appendicitis, with a tumor mass presenting over the appendix region, the possibility of tuberculosis must be considered. It must be borne in mind, too, that a patient suffering with tuberculosis may present acute abdominal symptoms due to a secondary pyogenic infection of the ulcerative or caseous type.

Actinomycosis.—This disease may possibly be diagnosed after it has advanced to the stage of abdominal wall infiltration or involvement. In its early development, its acute symptoms will, in all respects, simulate an acute appendicitis, while in its slow progression it may resemble a chronic appendicitis. The subsequent mass, with a gradual abdominal wall involvement, which gives rise to a brawniness of the skin and underlying tissues and sinus formation, will form a tentative diagnosis. If the ray-fungus is isolated, the diagnosis is complete.

Cysts

There seldom, if ever, arises a case in which a clinical diagnosis of an appendical cyst can be made. In these cases there is chronicity and at times acuteness, depending upon a secondary pyogenic involvement of the cyst.

Tumors

Benign.—These tumors may be considered as pathologic possibilities but are of little significance clinically.

Malignant.—Sarcoma and carcinoma should be considered only from the standpoint of pathologic interest. A chronic history of appendicitis with the formation of a tumor mass may suggest their existence, and if it can be concluded that the mass is not directly connected with the intestinal tract, a tentative diagnosis may be considered.

DIFFERENTIAL DIAGNOSIS OF CONDITIONS CAUSING ACUTE PAIN

Symptom	Acute Appendicitis	Acute Enterocolitis	Acute Pyelitis (Primary)
Age	18-30, rare before 2 and after 60. Any.	Especially infants. Any.	Especially, infants, children, pregnant women.
Pain (type and radiation)	Sharp and intermittent or sharp and more or less continuous. (1) Lower portion of right upper abdominal quadrant, diffuse, then at McBurney's point. (2) Diffuse, right lower quadrant. (3) Epigastrium, diffuse, right lower quadrant.	Diffuse, usually not severe. May be most pronounced in right lower quadrant.	May or may not be present. If present, sharp and intermittent type, radiating from back and upper quadrants to and along course of ureter. Maximum amount in kidney region and upper quadrants. May be diffuse.
Shock	Not present unless certain types of peritonitis develop.	No.	If toxemia extreme, may have varied degrees.
Temperature	May be normal. As a rule, between 99-101.	Usually slight. May be high.	Usually high rise with slight morning remissions.
Rigidity and tenderness	Rigidity, practically always present in some degree over cecum and usually marked in right lower quadrant, over McBurney's point. May be diffuse rigidity most pronounced in right lower quadrant. Tenderness marked over McBurney's point. If situated in pelvis, may be pronounced in lower portion of right lower quadrant or in suprapubic region. May be diffuse. Extent of tenderness depends upon location of appendix and degree of the inflammatory process. Rectal examination may elicit both signs.	Rigidity absent or slight. Tenderness generalized but not severe.	Usually pronounced over costovertebral angle and at times in upper abdominal quadrants.
Mass	Absent or present. Present, if abscess, or adhesions about appendix with surrounding inflammatory tissue with or without encircling omentum. Mass, if present, is more or less parallel with Poupart's ligament. May be pelvic mass or one felt by rectal or vaginal examination.	No.	If abscess, mass may be felt over kidney region.
Blood	Leukocytosis, as a rule. Increase in polymorphonuclear cells.	May be slight leukocytosis; may be marked leukocytosis.	Leukocytosis to moderate degree; if abscess, may be marked.

IN THE RIGHT LOWER ABDOMINAL QUADRANT

Intestinal Obstruction	Perforation of Typhoid Ulcer	Omental Torsion
Any.	Especially young adult and adult life. Any.	Any. Usually adults.
Depends upon site of lesion. If situated in lower right quadrant, most especially in this area; sharp, intermittent and colicky, radiating over entire abdomen. Rarely localized in one particular quadrant.	Sudden, sharp, starting at first in right, lower quadrant and soon becoming diffuse. May at first be diffuse and then most pronounced in right, lower quadrant. May be sudden increase of previously mild pain.	Diffuse, sharp and constant, most intense over site of torsion. Often lesion is located in right lower quadrant.
May or may not.	At first, may be marked or slight; always increases rapidly.	No.
No.	That of typhoid fever. Following perforation, drops, followed by high rise.	Negative, unless necrosis with infection.
Rigidity is absent, slight or marked. Tenderness is usually diffused, though it is often most marked over site of lesion.	Rigidity becomes very definite after from a few minutes to a few hours following perforation; it usually appears first and is most marked over right lower quadrant. Tenderness is usually diffuse and especially marked over right lower quadrant.	Diffuse, but most pronounced over site of torsion.
If obstruction is due to tumors, intussusception or volvulus, mass usually felt (may not); if due to encircling bands, strictures, enteroliths and the like, mass not observed. Rectal or vaginal examination may detect presence of such.	No.	Usually present.
Possibly signs of anemia. May be hyperleukocytosis due to intestinal accumulation.	Leukopenia, followed by slight rise in white blood-cells. Positive Widal reaction.	Negative, unless infection, in which case, leukocytosis.

DIFFERENTIAL DIAGNOSIS OF CONDITION CAUSING ACUTE PAIN IN

Symptom	Acute Appendicitis	Acute Enterocolitis	Acute Pyelitis (Primary)
Stools	Negative.	Usually diarrhea with mucus, possibly small amounts of blood.	Negative.
Urine	Negative, unless bladder becomes involved, in which instance large numbers of pus cells may be found.	Usually negative.	Large number of pus cells, especially in clumps, with resulting albuminuria. Bacteria usually found.
Special data	There are so many atypical cases of appendicitis, that one should always bear in mind, its possible occurrence in any acute abdominal condition. Nausea and vomiting, usually present.	Improper feeding and the hot summer months are often etiologic factors. At times, vomiting.	Often history of an infectious disease, long standing cystitis, gonorrhea, trauma. Repeated chills and collapse, not uncommon.

THE RIGHT LOWER ABDOMINAL QUADRANT (*Continued*)

Intestinal Obstruction	Perforation of Typhoid Ulcer	Omental Torsion
Negative results from enemata, or only slight. May be complete obstruction; perhaps ribbon shaped; blood and mucus.	Diarrhea or constipation. Typhoid bacilli found.	Normal.
Negative or signs of nephritis.	May be signs of nephritis. Positive Diazo reaction.	Normal.
Previous operations are often etiologic factors. Intussusception in the baby, volvulus in adults. Malignant tumors, usually in adult. Benign tumors, as a rule in young adult or adult. Usually visible peristalsis, distention, nausea and vomiting.	As a rule, perforation occurs in third week of the disease and usually in the severe cases; may occur in ambulatory type. Most common site, in last foot of ilium, hence first signs in right lower quadrant. Distention. Rose spots, enlarged spleen.	Practically impossible to make a definite clinical diagnosis; vomiting often severe.

(Table continued on page 652.)

DIFFERENTIAL DIAGNOSIS OF CONDITIONS CAUSING ACUTE PAIN IN THE RIGHT LOWER ABDOMINAL QUADRANT (Concluded)

Symptom	Ovarian Cyst Torsion	Extra-uterine Pregnancy	Acute Salpingitis	Ureteral Calculus	Strangulated Hernia (External or Internal)	Hip Tuberculosis
Age	Especially 16-40. Any.	Childbearing period.	Especially 18-40.	Adults.	Any.	Especially during first ten years. Particularly after second year.
Pain (type and radiation)	Diffuse, severe, becoming constant in right or left lower quadrant. If peritonitis develops pain will again become diffuse.	1. Acute and diffuse with no localization. 2. Dull and intermittent in pelvic region. 3. Dull and intermittent in pelvic region followed by very sharp and sudden pain which quickly becomes diffuse and relocates in right or left lower quadrant. 4. Acute in right or left lower quadrant which may or may not become diffuse.	Sharp and continuous; may be paroxysmal. Most often begins in one of lower quadrants and may continue to remain in these regions. Radiation may be over entire abdomen, perhaps extending upward over upper abdominal quadrants. Acute pain in lower back region often present.	Present in acute attacks; radiation from back along course of ureter and perhaps to genitalia on affected side. May be generalized.	Sharp and usually sudden over site of hernia which may remain localized or become dif-fused.	Very rarely acute. Often dull or moderately sharp pain in hip, often radiating down thigh. May be referred entirely to knee. In rare cases, in one of lower quadrants.
Shock . . .	Not unless general peritonitis.	Present in vast majority of cases.	Not present, unless perforation, with general peritonitis, occurs.	There may be a moderate shock in acute attack (from pain).	Very unusual.	No.
Temperature	If infection occurs, rise. Usually not present.	No or slight. Sudden drop with gradual rise.	At first high rise with morning remissions. Gradually becomes lower. May be only slight rise.	Not present.	Normal. Later may be slight rise.	Usually slight rise in afternoon and evening.
Mass	Present. Felt in one of lower quadrants, especially by vaginal examination.	Present. Felt in pelvis, either retro-uterine or in one of the lower quadrants; always noted on vaginal examination.	Usually felt in one of the lower quadrants on vaginal examination.	No.	Present in external hernia; absent in internal hernia.	No abdominal mass.

Rigidity and tenderness	Usually more or less diffuse, but most pronounced over one of lower quadrants and pelvic region, in general.	With rupture: Diffuse and most marked over pelvic region in general. Without rupture: Over one of the lower quadrants.	In early stage pronounced over one of lower quadrants (acute). As disease becomes of a more chronic nature there may be no rigidity and but slight tenderness, which is best elicited by vaginal examination.	May be slight in back or one of lower quadrants.	If external, slight rigidity of lower abdomen. If internal, rigidity and tenderness usually marked. If external, there is, as a rule, exquisite tenderness over protrusion.	Tenderness and rigidity, at times, over psoas area; tenderness over hip region, often extending down thigh; hip movements cause rigidity.
Blood . . .	Negative, unless infection, in which case, leukocytosis.	If ruptured, there may be a marked leukocytosis, due to intra-abdominal blood.	Leukocytosis to moderate degree. May be high.	Normal.	Normal.	Normal or signs of anemia.
Stools . .	Normal.	Normal.	Normal.	Normal.	Complete constipation, not relieved by enemata unless epiplocele alone.	Normal.
Urine . . .	Normal.	Usually normal.	Usually normal.	May be complete suppression from one side; urine may contain large amounts of blood or granules of calculus.	Normal.	Normal.
Special data	Occasionally occurs in children and should always be borne in mind.	Often in women with a more or less protracted period of sterility. Occasionally signs of pregnancy. Uterine bleeding commonly found. Abderhalden reaction. Nausea, vomiting, usually distention.	Often history of instrumentation, abortion, gonorrhea, leukorrhea and pregnancy. At times, chills. Frequent urination.	Radiographic and cystoscopic examination will diagnose case.	External herniæ, common.	Tuberculin test positive. Frequent history of night cries. Lameness or stiffness of hip joint. Radiographic examination confirms diagnosis. Progressive.

DIFFERENTIAL DIAGNOSIS OF CONDITIONS CAUSING

Symptom	Appendicitis (Chronic)	Tuberculosis (Cecal)	Intestinal Obstruction
Age	Any. Mostly young adults.	Childhood. Adult age.	Any.
Pain (type and radiation)	Fairly constant, grumbling type, or occasionally moderately sharp. Localized or radiating toward pelvis, loin, upper quadrant or umbilicus.	Absent, or simulating partial intestinal obstruction.	Cramplike, intermittent, or fairly sharp. Localized or radiating to right lower quadrant.
Temperature	Normal, excepting during exacerbations.	Slight elevation.	Normal.
Abdominal rigidity ..	Slight or more marked, according to condition of appendix. Usually greatest over McBurney's point.	Absent or moderate over cecum.	Absent, or moderate.
Abdominal tenderness	Slight or moderate, greatest over McBurney's point.	Absent, or moderate.	Same.
Mass	None.	Firm, deep-seated, irregular mass. Movable in early stages; later fixed. May attain large size.	Depending upon cause of obstruction.
Urine	Negative.	Negative.	Negative.
Special data	Often history of acute attacks. Reflex gastric symptoms, common.	Primary or secondary. Lesions elsewhere in body. Loss of weight and strength. Gastrointestinal disturbances. X-ray.	Increasing constipation. Reflex gastric symptoms. May observe peristalsis or patterns, or palpate mass. Radiography, including barium enema.

CHRONIC PAIN IN RIGHT LOWER ABDOMINAL QUADRANT

Ureteral Calculus	Ureteral Stricture	Pelvic Peritonitis	Retroperitoneal Tumor
Young adult and adult.	Mostly adult.	Mostly young adults. Puberty to menopause.	Any.
Dull or moderately sharp, localized, or radiating to back, pelvis or thigh.	Localized in right lower quadrant. May radiate to back or pelvis. May be of renal colic type.	Deep-seated, usually bilateral in lower quadrants. Worse during menstruation. Intermittent inflammatory or obstructive attacks.	In lower, or lower and upper quadrants. Often in loin or back.
Negative.	Negative.	Normal or elevated.	Negative.
In lower quadrant. Often in loin and costovertebral angle.	Absent or slight.	Usually bilateral. May be more pronounced on one side than the other.	Absent, or moderate over mass.
Deep-seated, in lower abdomen at or below McBurney's point.	Same.	Usually bilateral.	Same.
None.	None.	Uni- or bi-lateral, or none.	Deep-seated, fixed, smooth or nodular, large or small. Overlaid by tympany. Extends toward loin, kidney region or central abdomen.
Occult or gross blood. Often pus cells.	Negative, or signs of renal impairment or infection.	Negative.	Negative.
History of hematuria, renal colic, or urinary symptoms—especially increased frequency.	History of urinary disturbances; attacks resembling renal colic or Deitl's crisis; of kidney infection, tuberculosis, renal calculus or surgical injury. Cystoscopy with ureteral catheterization. X-ray. Pyelogram.	History of vaginal discharge. Acute exacerbations. Pelvic tenderness. Fixity of uterus. Bilateral pelvic thickening, or mass on one or both sides of uterus. Signs and symptoms often like intestinal obstruction.	Many malignant; especially in infants; cause constitutional symptoms. Diagnosis to be made by exclusion of intestinal and genito-urinary origins.

AFFECTIONS OF THE CECUM

Inflammatory Conditions

Acute inflammation of the cecum (typhlitis) accompanies every moderately advanced case of appendicitis. Some observers claim that in many cases the inflammation process is primary in the cecum, extension to the appendix occurring by direct extension, pressure and obstruction to the appendical lumen and interference with the blood supply. The wall of the cecum is injected, thickened, edematous, while the surface may be covered with a serofibrinous exudate. As the infection increases the cecal wall becomes friable and may perforate. Symptoms are similar to those found in acute suppuration of the appendix, so that differentiation is impossible and unnecessary.

A mild, benign typhlitis has been described by Dieulafoy. This is held to be due to stasis in the cecum and ascending colon. There, the fecal contents are still semiliquid and are more active in gas production than farther along the colon. This irritation gives rise to a mucomembranous colitis in the cecum, which resembles a mild attack of appendicitis but without muscular rigidity and usually without vomiting. The distended cecum may be palpated as a soft, elastic cushion. The symptoms rapidly subside, to be followed frequently by mild diarrhea with the passage of mucus.

The cecum is frequently *enlarged* and *displaced* as the result of congenital malformations, fecal stasis (ascending constipation), or inflammatory adhesions. Such conditions may mimic a very mild, chronic appendicitis, but in many cases no discomfort is induced.

Granulomata

Tuberculosis of the cecum is primary or secondary to the same infection elsewhere. Where primary, it is thought that the organisms have gained entrance with the ingesta and have attacked the cecum because of intestinal stasis in that region. The disease is most common between twenty and forty, but may occur at any age. There is an enteroperitoneal and an hypertrophic type; the former gives rise to symptoms similar to those of chronic appendicitis. A slowly developing, bloody diarrhea or sudden pains in the right iliac fossa may be the first of the symptoms. The inflammation spreads slowly toward the median line and may be detected by pelvic examination. Eventually, suppuration occurs with discharge through fistulæ to the abdominal wall or into the intestinal tract. Rarely, the suppuration may be discharged into the peritoneal cavity, causing a fatal termination.

The hypertrophic form is by far the more common, beginning insidiously with loss of appetite, impaired digestion and ill-defined, disagreeable sensations in the right lower abdominal quadrant. The process may remain stationary for many months, or even seem to improve under treatment. Finally, alternate diarrhea and constipation ensue with colicky pains and local meteorism coming on a few hours after eating. At this stage a tumor mass in the right iliac fossa can often be seen as well as palpated. This mass is elongated, lies in the axis of the cecum, is nodular and often quite hard. It can often be moved transversely, but not verti-

cally; the lower pole is more distinct than the upper, which blends with the colon. Occasionally, tenderness on pressure may be elicited and the normal resonance of the bowels is not obtained by percussion. Fever is usually present; the stools contain blood or a mucopurulent discharge; vomiting and slight rigidity of the abdominal muscles may be present during the attacks of pain. Anemia and malnutrition increase, the patient grows weaker, destruction becomes more complete and death is the invariable result.

Actinomycosis of the cecum is an unusual condition. Slesinger (*Lancet*, 1920, 198:1220) distinguishes three types of clinical pictures under which the disease appears. In the first and most common variety, a painless and progressively enlarging tumor develops in the right iliac fossa, with the ultimate formation of abscesses and fistulæ. The second type has a more acute onset, resembling very strongly an ordinary attack of appendicitis, while, as a matter of fact, the appendix is often found in a gangrenous condition. In the third class an infected area appears in the wall of the gut, proceeds to perforate and gives rise to a diffuse peritonitis. All these conditions are more frequently found in farmers, or workers in grain; and usually in men. The onset may be ushered in by an attack of catarrhal colitis, followed by the formation of a small or large, hard, insensitive tumor mass in the right iliac fossa. As the condition extends the mass becomes less and less movable. The overlying skin may become involved and break down into tortuous, draining sinuses. The general health may be poor, fever may be moderate but stenosis of the bowel is rare. The characteristic yellow granules will be discovered in the pus exuding from the sinuses.

Tumors

Carcinoma occurs frequently in the cecal region in persons past middle life. Often there is, at first, alternating constipation and diarrhea, but the first symptoms may be those of intestinal obstruction. A tumor mass is found in the right iliac fossa, hard, immovable, and usually not tender. Pain may be present, growing more severe as pressure and obstruction increase. Cachexia and anemia precede the fatal termination. Sarcoma is a clinical rarity; a clinical diagnosis cannot be made. Radiography will probably localize the site of obstruction. See "Tumors of Large Intestine."

CHAPTER XX

LARGE INTESTINE, RECTUM AND ANUS

AFFECTIONS OF THE LARGE INTESTINE

Congenital malformations	{	Hirschsprung's disease transposition multiple diverticula
Injuries	{	contusion penetrating wounds rupture
Inflammatory conditions (colitis)	{	acute catarrhal acute hemorrhagic or ulcerative acute phlegmonous acute diphtheritic chronic mucous chronic ulcerative
Dysentery	{	bacillary (infectious diarrhea) amebic
Granulomata	{	actinomycosis tuberculosis syphilis
Diverticulitis	{	acute chronic
Volvulus		

Tumors	{	benign	{	lipoma fibroma lymphoma myxoma osteoma adenoma polyp papilloma myoma teratoma chylangioma enterocystoma mixed form
			{	sarcoma endothelioma carcinoma

Congenital Malformations

Hirschsprung's Disease.—Of the congenital anomalies which may affect the large intestine, congenital dilatation of the colon, known as Hirschsprung's disease, is the most important. This condition is by no means frequent. The symptoms are distinctive, and date from infancy or childhood. The child suffers from marked constipation, and the abdomen shows a tremendous distention. This enlargement is not painful, however, excepting during intermittent attacks resembling obstruction, so frequently present in individuals with this disease. At other times, the abdominal wall, although stretched and tense, is not in the least rigid. Diarrhea often follows periods of unusual constipation: Extraordinarily large amounts of feces may then be passed. The diagnosis is, as a rule, obvious even without radiography, which may, however, be utilized.

Transposition.—A rare anomaly is transposition of the colon and sigmoid, this occurring as part of a generalized visceral transposition. Rarely, the descending colon is found in the right side of the abdomen, or the ascending colon on the left side.

Multiple Diverticula.—Undoubtedly, multiple diverticula of the colon occur in many instances, on a developmental basis.

Injuries

Injuries of the large intestine include contusion, penetrating wounds and rupture. These have been described under "Abdominal Injury."

Apart from a traumatic causation, rupture of the intestine may also develop spontaneously, commonly as a complication of malignancy, with intestinal obstruction, and intestinal ulceration.

Inflammatory Conditions

Acute inflammatory processes involve the small as well as the large intestine. Either a division of the gut may exhibit the predominant lesions or one section may be affected to a greater extent than the other. The condition is known as enterocolitis, and comprises (1) catarrhal, (2) ulcerative, (3) phlegmonous, and (4) a diphtheritic or membranous form.

Acute catarrhal enterocolitis occurs more frequently in children than it does in adults. The onset is rapid, with diarrhea, often tenesmus, nausea and vomiting. The stools are frequent, watery in character and with large amounts of mucus present.

Dietary error, especially in children, precedes most cases. Ingestion of irritating drugs, or of water or milk accounts for others. In children, high leukocytosis and evidences of acidosis are usually present. Diffuse abdominal tenderness is a frequent accompaniment, leading at times to errors in diagnosis.

Acute ulcerative enterocolitis presents the same symptoms but in an aggravated form, and small amounts of blood and pus usually appear in the stools. Examples of this condition are bacillary and amebic dysentery.

Acute phlegmonous enterocolitis is an extremely virulent infection of the

gastro-intestinal tract, characterized clinically by severe toxemia and prostration, persistent tenesmus and frequent stools, containing mucus, pus, blood and frequently necrotic tissue or portions of mucous membrane.

Acute diphtheritic enterocolitis is unusually rare. Its main difference from the above is pathologic.

Chronic colitis, also called mucous colitis and ulcerative colitis, is a chronic inflammatory condition which may follow a severe acute colitis, or may develop gradually. The symptoms consist of frequent, watery stools containing large quantities of mucus, often pus, and sometimes blood; impaired appetite; gradual loss of weight and strength; and occasional attacks of griping abdominal pain. Since the sigmoid and rectum commonly share the inflammation, tenesmus and the other symptoms of chronic proctitis are commonly associated. Although temporary improvement may occur during certain periods, the diarrhea is essentially persistent and progressive. It is apparently aggravated by certain foods, such as fruits and those with bulky residue.

Physical examination may be entirely negative. Many patients, in addition to evidence of loss of weight and strength, show a somewhat distended and tympanitic abdomen and tenderness upon palpation along the course of the colon, particularly over the splenic flexure and the descending colon. Proctoscopy and sigmoidoscopy are often quite conclusive, and should be done in all suspected cases. The mucosa appears diffusely inflamed, injected and is considerably thickened. Papillary elevations due to enlarged follicles are quite striking and superficial ulcerations and tiny capillary bleeding sites are frequently observed. If such a visual picture appears to extend upward, one may be practically sure of similar involvement of the colon.

Radiography is highly suggestive, if not definitely conclusive. The most valuable data are obtained by means of the barium enema. In true mucous colitis, using the fluoroscope screen, the barium is seen to shoot rapidly upward through the colon and across to the cecum, as though it were being forced through a greased tube. Other evidences of hypermotility may be found on radiographic films or pictures.

In the final diagnosis, care should be taken to exclude chronic amebic colitis, by means of the history and repeated examinations of the stools. It is also necessary to rule out tuberculosis, tumors, foreign bodies and diverticula of the colon.

Dysentery

Dysentery occurs in two forms, according to etiology: (a) Bacillary dysentery, produced by various organisms of a similar strain, notably the Shiga and Flexner type, and (b) amebic dysentery, in which the *Entamoeba histolytica* is the causative factor.

The symptoms are similar in the two affections, consisting of diarrhea, tenesmus, griping abdominal pains, thirst, rapid loss of weight and strength and toxemia. The stools contain mucus, pus and blood, the latter usually in small amounts.

The onset is quite acute in bacillary dysentery; this disease in children is often called "infectious diarrhea." The amebic form is also commonly acute, but

many subacute and chronic types are observed. A complication of particular interest is an hepatic abscess.

The differential diagnosis depends upon the bacteriologic findings in the stools. The agglutination reactions in bacillary dysentery may be utilized, but are often unsatisfactory. At times, definite appendical attacks in the course of a dysentery infection demand recognition and surgical intervention. (Heuyer and Leveuf, *Arch. de mal de l'appar. digest.*, 1920, 10:385. Martin and Williams, *Brit. M. J.*, April 1, 1917, p. 479).

Granulomata

Actinomycosis of the large intestine is found in the cecum in 60 per cent of cases of abdominal infection by the ray-fungus. But the condition may occur at any point in the colon and gives rise to either acute or chronic symptoms. Great care must be used in differentiating this disease from malignancy or tuberculosis. The acute form may simulate closely an attack of acute appendicitis; indeed, the two conditions often occur at the same time. At operation the characteristic pus may be found in the appendix and cecum or a persistently draining postoperative sinus will finally reveal its true etiology. In the chronic variety there is a history of irritability of the colon, diarrhea, and slight dull pain in the lower left or right quadrant, depending on the site of the affection. A slowly growing, painless tumor mass appears in the region of the dull pain, becoming less freely movable as it increases in size. This may be mistaken for tuberculosis or carcinoma and often the correct diagnosis is not made until a sinus forms, draining the characteristic pus (Slesinger, *Lancet*, 1920, 198:1220; F. W. Rankin, *Surgery of the Colon*, D. Appleton & Co., 1926, 34-45).

Tuberculosis of the colon occurs as an hyperplastic growth or ulcerative colitis, usually in the course of a marked pulmonary involvement. The diagnosis with either type will be suggested by an hereditary tendency, previous history, foci of tuberculosis elsewhere and slow progression. As a rule, the patient becomes worse without an increase of pulmonary signs or even with an improvement in the pulmonary signs and symptoms. He develops extreme nervousness, dyspepsia, a feeling of fullness or discomfort in the abdomen after eating, slight irregular rise in temperature and failure to gain weight under favorable conditions; tuberculous colitis must then be strongly suspected. On palpation a slight thickening of the colon may be made out. The symptoms of tuberculosis of the colon may be as indefinite as those of early pulmonary infection.

The hyperplastic form is found most frequently in the cecum and ascending colon, in the same regions preferred by actinomycosis and carcinoma. Several areas may be involved, but usually there is limitation to one region. The term *tuberculoma* is now being used to designate both the underlying cause and the tumor formation. There is an hyperplasia of the wall without involvement of the mucosa; rarely, the growth may be so large that the mucosa is secondarily ulcerated; such a state, however, is not the primary condition. A mild mesenteritis causes a shortening and thickening of the mesentery and the regional lymph glands will enlarge and coalesce. Tuberculous peritonitis is rarely present in the same case. In the early stages the diagnosis is especially difficult because of the vagueness of the symptoms which are dyspepsia, mild ache in the right

iliac fossa and constipation. Finally a tumor mass is discovered in the region involved, doughy on palpation, slowly developing, very slightly tender and fairly firmly fixed. Eventually, obstructive symptoms arise. Cachexia and anemia are added to the clinical picture. X-rays are of great diagnostic value.

The ulcerative type of tuberculosis of the colon usually involves the cecum but the entire large bowel may be affected. In practically all cases there is the same infection elsewhere in the body, usually in the lungs but often in the kidney, lymph-nodes, or epididymis. The symptoms appear more rapidly than in the hyperplastic form. There is early persistent diarrhea, increasing in severity and often associated with hemorrhage from the bowel, which leads to anemia and exhaustion. The stools have an offensive odor, contain necrotic material and blood and the tubercle bacilli. Loss of weight is an early constant finding. Radiographs will aid greatly in forming a correct diagnosis. Complications which may arise are stricture, hemorrhage and perforation (Brown and Sampson, *J. Am. M. Ass.*, 1919, 73:77; F. W. Rankin, *Surgery of the Colon*, D. Appleton & Co., 1926, p. 196).

Syphilis of the colon may give the same symptom-complex as tuberculosis or carcinoma; that is, diarrhea, with pus and blood, abdominal pain and mass. This condition is relatively rare and, when present, usually occurs in the descending colon as a gummatous tumor. A history of a specific infection, positive blood Wassermann test and a slow, chronic course will aid in forming a diagnosis. The radiogram may be similar to that found in carcinomatous affections.

Diverticulitis

Diverticulitis is any inflammatory change in any diverticulum or series of diverticula, found most frequently in the sigmoid flexure, but present in other parts, especially the flexures of the colon. The true nature of such an affection has been given too little attention. The diverticula tend to conceal themselves and the secondary processes are usually very extensive and disproportionate to the original pathology. The diverticula may be single but as many as two hundred have been found in one colon. The affection is most frequently encountered in the middle decade of life and usually in men. Congenital weakness and constipation are theoretical causes. Prodromal symptoms are abdominal uneasiness, digestive disturbances, constipation and flatulence. The actual onset of definite symptoms may be acute, with signs of inflammation and the presence of a tumor mass in the left lower abdominal quadrant. There may be abscess formation or rupture, with general peritonitis, intestinal obstruction—a mimicry of carcinoma. In 50 per cent of the cases there is a tumor formation or abscess. The sigmoidoscope and radiography will make the diagnosis exact. Mayo states that the symptoms of diverticulitis resemble those of appendicitis, except that in a great majority of cases, the symptoms are most severe on the left side, when diverticulitis is present. (Telling, *Lancet*, Jan. 10, 1926; Mayo, *J. Am. M. Ass.*, 1917, 69:781; S. G. Gant, *J. Am. M. Ass.*, Oct. 24, 1921, 1415-1420).

Volvulus

(See chapter on "Intestinal Obstruction.")

DIFFERENTIAL DIAGNOSIS OF CONDITIONS CAUSING ACUTE PAIN IN THE LEFT LOWER ABDOMINAL QUADRANT

Acute enterocolitis.....	
Acute pyelitis (primary)	
Intestinal obstruction ...	
Omental torsion	
Ovarian cyst torsion....	
Extra-uterine pregnancy.	See Differential Chart, pages 648-653
Acute salpingitis	
Ureteral calculus	
Strangulated hernia (external or internal)...	
Hip tuberculosis	
Acute diverticulitis (sigmoid)	Essentially a disease of middle decade of life; most especially found in men. Prodromal symptoms may be sense of uneasiness in lower abdomen, constipation and flatulence. Actual onset may be sudden and attended with exquisite pain in left lower abdominal quadrant radiating over entire pelvic region. Tenderness and rigidity of the muscles of the left lower quadrant often present. A definite, rather indurated mass may be felt both by rectal and abdominal examination in lower left quadrant. Resembles an acute appendicitis with exception that the signs and symptoms are situated on the left side. It may be confounded with sigmoid carcinoma. The sigmoidoscope and radiograms may confirm diagnosis.
Acute sigmoiditis	As a rule, occurs in middle life. Pain which may be sharp or of a dull nature, generally confined to the left lower quadrant and radiating to rectum and at times to the perineum. No mass is present unless a definite perisigmoiditis exists. The stools usually contain variable amounts of mucus and blood; examination with the sigmoidoscope aids in diagnosis.
Volvulus	Occurs more often on the left side, while intussusception presents especially on the right. Volvulus is a lesion of the adult, while intussusception is a disease of infants and small babies. See Chapter, "Intestinal Obstruction."
Carcinoma of large intestine and rectum	Of sigmoid and rectum: the commonest causes for acute obstruction with symptoms primarily presenting in left lower quadrant. See Chapters, "Intestinal Obstruction," and "Affections of Large Intestines."

Tumors

Benign tumors of the large intestine are of surgical and pathologic interest because of their tendency to produce obstruction (either acute or chronic), to occasionally degenerate into malignancy, at times to give rise to symptoms other than obstruction, detrimental to the health of the patient (such as acute bleeding or oozing, pain and digestive disorders). F. W. Rankin (*Surgery of the Colon*, D. Appleton & Co., New York, 1926, p. 214) quotes the findings of Dewis (*Boston M. & S. J.*, 1906, 155:427) who in 1906 "reviewed exhaustively benign tumors of the gastro-intestinal tract and reported 219 cases located in the intestine, including both the large and small bowel. He divided them as follows: myomata 40; adenoma 127; lipoma 44; fibromata 5, and angiomatica 3. He noted that twenty-five per cent of the adenomata appeared in the large bowel, not including the rectum, while 27.1 per cent of all other forms of benign tumors

DIFFERENTIAL DIAGNOSIS OF CONDITIONS CAUSING

Symptom	Chronic Colitis	Diverticulitis	Fecal Impaction
Age	Any; common in childhood and adult.	Congenital or acquired.	Any; chiefly adults.
Pain (type and radiation)	Colicky, cramplike, diffused throughout abdomen or along course of colon.	Varies in character according to complications, viz., inflammation, obstruction, fecal impaction, ulceration, peri-inflammation.	Localized along colon and sigmoid, or diffuse abdominal pain with local increase.
Temperature ...	Elevated, in exacerbations.	Fever, during inflammatory stages.	Normal or elevated.
Abdominal rigidity	Common in left lower quadrant.	Absent or moderate over colon. Increased in presence of complications.	Absent or moderate.
Abdominal tenderness	Common along course of colon.	Some.	Over palpable mass.
Mass	Distended colon may be felt.	If inflamed, impacted or obstructed, mass in course of colon, or adjacent thereto.	Large or small mass in left lower quadrant. Dulness. Somewhat mobile. Can be indented with finger.
Stools	Constipation alternating with diarrhea; mucus, pus, blood at times; bacteriology.	Constipation; diarrheal attacks. May be blood.	Difficulty in bowel movements.
Special data	Occurs alone or as part of enterocolitis. Common sequel of acute dysentery, bacillary or amebic types. Loss of weight and strength in late stages. Exceedingly rapid progress of barium enema, noted with fluoroscope. Congestion and ulceration may be observed in lower intestinal canal, through sigmoidoscope. Secondary gastric symptoms.	Symptoms vary according to pathologic state. Mass may appear to be outside colon. Often resembles colitis or partial intestinal obstruction or new growth. X-rays sometimes diagnostic.	History of constipation. Temporary gastric symptoms. Sigmoidoscopy. Clinical effect of enema and catharsis.

occurred in the colon." King (*Surg., Gynec. & Obst.*, 1917, 15:54) has added nine more benign tumors of the colon to the literature; namely, six lipomata, one fibroma, one benign polyposis and one papilloma.

The symptoms produced by any of these tumors depend for the most part upon (1) the size of the mass, (2) upon its location, (3) presence of peduncu-

CHRONIC PAIN IN LEFT LOWER ABDOMINAL QUADRANT

Carcinoma of Sigmoid	Aneurysm of Iliac Artery	Pott's Disease	Symptom
Middle and advanced.	Middle and advanced.	Childhood; occasional in adults.	 Age
Often absent until late. Deep-seated, annoying type of pain; or nerve pressure with severe pain. Or colicky, intestinal pain of partial obstruction.	Localized in left lower quadrant, or radiating to back or thigh. Dull aching, or sharp pain from nerve pressure.	In left lower quadrant. Usually back, also.	Pain (type and radiation)
Normal or slight elevation.	Normal.	Usually elevation.	... Temperature
Absent, or moderate in left lower quadrant.	Absent, or induced by palpation.	In abdomen, often in back, or radiating into thigh.	Abdominal rigidity
Deep in left lower quadrant above pelvic brim.	Over mass.	Deeply in lower left quadrant, toward lateral pelvic wall.	Abdominal tenderness
If large, an irregular, hard mass, usually somewhat fixed.	Rounded or oval, tense or firm, slight mobility or fixed, in left lower quadrant. Expansile pulsation, bruit, perhaps thrill. Overlying tympany.	May feel definite mass along psoas muscle, or apparent thickening and induration of muscle. Mass may point beneath Poupart's ligament.	 Mass
Constipation or diarrhea; blood in stools.	Negative.	Negative.	 Stools
May be felt on rectal palpation if not too high, or seen with sigmoidoscope. Radiography, with barium enema. Clinically appears, as colitis or partial obstruction. May be rectal shelf.	General symptoms and signs of arterial hypertension. Syphilitic or arteriosclerotic basis. Perhaps difference in blood-pressure in two extremities; pressure effects on accompanying vein. Secondary intestinal symptoms from compression. May be positive Wassermann reaction.	History of night-cries, girdling pains, gastric disturbances. Posture and stature. General appearance. Kyphosis. Spinal rigidity, and restriction. Hip flexion. Radiography. Tuberculin test.	... Special data

lation and its extent, (4) length of the mesentery in the neighborhood of the growth, and (5) ulceration. There is no definite train of symptoms pathognomonic of the benign large intestine tumors apart from the radiographic findings which are, as a rule, complete proof. The symptoms are those referred to under "Intussusception," "Volvulus" and "Acute and Chronic Colitis."

Malignant tumors of the large intestine include sarcoma, carcinoma and endothelioma. *Sarcoma* occurs, as a rule, in younger periods than carcinoma, and is more rapid in progression. Various types of sarcoma are met with. They are more common in males. Occurrence is less frequent in the large than in the small intestine. One of the earliest symptoms is bleeding from the rectum. This may be associated with or preceded by vague lower abdominal pain. Distention and other symptoms of chronic obstruction are relatively late. In the sigmoid and lower colon the growth may be seen with the sigmoidoscope or may be felt by rectum. Abdominal palpation may reveal a mass in the location of the colon. This is free in the early stages, later fixed. Radiography, especially with a barium enema, is of value.

The clinical course of *endothelioma* is similar to that of sarcoma.

Carcinoma of the colon and sigmoid is usually primary. It may occur secondarily to other pelvic sources. It is more common in middle and advanced life. Annular constricting carcinomata and ulcerative carcinomata are found. Preëxisting chronic processes, such as diverticulitis, dysenteric, tuberculous and syphilitic ulcerations may be the forerunners of carcinoma. The favorite locations are the sigmoid and lower colon, but carcinoma may be found in any part of the lower gut. The onset is always indefinite; usually with vague abdominal pain and slight distention. From this point, the symptoms include rectal bleeding and gradually increasing constipation (one or both), loss of appetite and strength and secondary anemia. A feeling of fullness in the lower abdomen, not relieved by ordinary measures and, in fact, with a tendency to become more pronounced, should elicit suspicion. Nausea may be present, but vomiting is uncommon. Acute intestinal obstruction may be the first indication of the presence of intestinal malignancy.

The same methods of diagnosis are employed as mentioned under the discussion of sarcoma. In the late stages, ascites may be found. In addition to a palpable mass, one should always look for abdominal asymmetry and visible peristalsis. The annular types, in the early stages, cannot be felt through the abdomen. Radiography is of great value. A rectal shelf may be felt.

AFFECTIONS OF THE RECTUM AND ANUS

Malformations	of the anus	{ - partial occlusion - complete occlusion - abnormal narrowing - anus opening at some abnormal point, as urethra, bladder, perineum, scrotum, sacrum - absence of anus
	of the rectum	{ - rectum opening into another viscus - rectum and anus normal, but another viscus, as ureter or bladder, emptying into rectum - rectum arrested in its descent - absence of rectum - partial obliteration of rectum - septate rectum

Inflammatory conditions	{	proctitis, acute
proctitis, chronic		
	{	abscesses {
		anal
		ischiorectal
		intrarectal (submucous)
		perirectal (pelvirectal, retrorectal)

Anal fistula

Anal fissure

Granulomata	{	tuberculosis
		syphilis
		actinomycosis

Hemorrhoids	{	internal
		external

Prolapse

Foreign bodies

Stricture

Pruritus ani

Diverticulum

Ulcerations	{	traumatic
		inflammatory
		congestive (portal)
		dysenteric
		tuberculous
		syphilitic
		actinomycotic
		diabetic
		nephritic
chancroidal		

Hysteria

Condylomata

Tumors and cysts	{	benign tumors and cysts	{	polypus
				adenoma
				papilloma
				fibroma
				lipoma
				myoma
				chondroma
				angioma
				myxoma
				pilonidal cyst
				sebaceous cyst
		Malignant tumors	{	epithelioma of anus
				carcinoma of rectum
				sarcoma
				endothelioma

Malformations

Malformations of the rectum and anus are numerous, although not frequently encountered. A glance at the classification will explain the various conditions which may be found. Diagnosis can be made upon careful inspection of the perineum and adjacent structures. When the anus is absent or completely occluded, the proximity of the rectum may be inferred by observing a localized bulging of the perineum when the child cries, or when pressure is made over the lower abdomen.

Absence of the rectum may be demonstrated by introducing a soft rubber catheter or a blunt probe into the anal canal. A more graphic method is radiography after barium or bismuth, combining intra-anal injection and oral ingestion, and thus obtaining complete comprehension of the abnormality as well as of the operative prognosis.

Abnormal opening of the anus or rectum can be easily ascertained by noting the escape of feces or meconium in that situation, or in the urine or vaginal secretions. Judicious probing or digital palpation, or the use of a coloring solution, such as methylene-blue, may be combined with the visual inspection.

Inflammatory Conditions

Acute Proctitis.—Acute inflammation of the rectal mucosa is manifested by pain upon defecation, tenesmus, sensations of heat and burning in the rectum or perineum, and the passage of mucus, pus and occasionally blood. Patients, especially children, may become quite prostrated. This is particularly true when the proctitis is part of a severe enterocolitis or dysentery.

Local pathologic conditions, such as hemorrhoids, tumors, gonorrheal and chancroidal infections, may stimulate a preëxisting proctitis. Occasionally, proctitis is the result of the perforation of a pelvic or periappendical abscess. Digital and visual examinations should be made when practical. The intense pain and tenderness often prevent such procedures.

Chronic Proctitis.—This is a condition that follows the acute form or arises independently. The latter pertains especially to tuberculous and syphilitic forms of the disease. Alternate diarrhea and constipation constitute the symptoms of chronic proctitis, together with occasional tenesmus and burning pain. Mucus is persistent in the stools, and pus and streaks of blood may be found from time to time. Examination may reveal hemorrhoids, a fissure or local ulceration. A diffuse injection and thickening of the rectal mucosa are observed, the papillæ being unusually prominent and enlarged. Their summits may show tiny ulcerations. Polypoid formation may also complicate chronic proctitis, and cicatrization may develop and lead to a stricture of the rectum.

Abscesses.—Those in and about the rectum are extremely painful. They arise in different anatomic situations, deriving their particular names, accordingly. When an abscess approaches the surface, there are inflammatory signs in the skin of the buttock or perineum, with tenderness and induration upon palpation. Before this stage is reached, diagnosis rests entirely upon careful rectal examination, which will reveal a mass in some relation to the rectum.

The onset is acute, with pain in the rectum or its vicinity, the pain being aggravated by bowel evacuations and motion; the sitting posture is frequently accompanied by a sense of fullness and burning; it is often most marked in the sciatic nerve distribution. The affection occurs particularly as a complication of chronic rectal conditions, such as hemorrhoids, fissure, fistula, ulceration and inflammatory processes. Pelvic inflammatory disease and a ruptured appendix account for a few cases.

The diagnosis of the type of abscess depends upon the anatomic situation: (1) The so-called *anal abscess* is merely a localized skin infection or furuncle near the anus. (2) The *ischiorectal abscess* lies in the fatty and areolar tissue of the ischiorectal fossa, lateral to the rectum, between it and the ischial tuberosity. It has a tendency to approach the surface, accompanied by all the usual signs of inflammation, but it may discharge into the rectum, it may burrow its way about the rectum and appear as a bilateral or circumferential affection. (3) The *intra-rectal abscess* is a submucous phlegmon, indicated by a bulging, fluctuant and tender mass within the rectum, which may involve the sphincter muscle, or be situated extraneous to it. (4) A *perirectal abscess* arises in the tissues adjacent to the rectum, either within the pelvis or behind the rectum. A tenderness is palpable above the tuberosity, and in front of, lateral to, or behind the rectum. It is hard and brawny, or it may show fluctuation. These abscesses often discharge through the rectum.

Anal Fistula

This consists of an abnormal communicating tract between the rectal mucosa and the skin of the perineum. A complete fistula, therefore, has two demonstrable openings, one within the rectum, and the other upon the skin. If, however, the fistula is incomplete, or a portion of it has been occluded, only a single opening is apparent, and the fistula is a "blind internal" or "blind external" one, as the case may be, the term referring to the situation of the one opening.

The symptom-complex of an intermittent discharge of pus from about the anus, and pain upon defecation, is quite characteristic of an external fistula, either complete or incomplete. If no external opening exists, pain is the attractive symptom.

In either type, abscess formation may result, causing a rise of temperature and perhaps a chill. The diagnosis may be made upon local inspection and palpation, using a probe or a colored solution to trace the course of the fistula.

Anal fistulae are associated with chronic inflammatory processes of the rectum, fissures and hemorrhoids. The frequent association of pulmonary tuberculosis is notable.

Anal Fissure

This condition is a linear ulceration, disposed in a radial manner in the skin of the anus. The edges are slightly gaping, and may become slightly indurated when long existent. Contact with a palpating instrument is extremely painful. The chief subjective symptom is severe pain upon defecation, this in turn causing constipation.

Fissures may be single or multiple. They are associated with various types of ulceration and inflammatory conditions, especially when a discharge is present.

Granulomata

The granulomatous affections of the rectum and anus include (*a*) tuberculosis, (*b*) syphilis, and (*c*) actinomycosis. The only common clinical characteristic of the three is chronicity.

Tuberculosis.—This affection occurs in various pathologic forms. The cutaneous condition appearing about the anus, is really a lupus, or a lupoid condition. At the mucocutaneous junction, or within the rectum, papillary and ulcerative types may be seen. Of these, the ulcerative tuberculosis is the most frequent, and is often associated with a fistula in ano, and very often with pulmonary tuberculosis.

The subjective symptoms are those of chronic proctitis. In the ulcerative form pain is usually severe, and the patient quite frequently tells of the passage of a few drops of bright red blood during or after defecation. Mucus is abundant in the stools.

Digital examination is usually painful. Proctoscopy is more satisfactory. In the papillary form, which is rare, multiple yellowish-white tubercles, projecting from the mucosa, are seen.

The ulcerative type may show single or multiple lesions, of irregular contour with shallow crater and soft edges. The base is composed of pale, indolent granulation tissue, with scattered yellowish nodules appearing on the surface, sometimes with a surrounding area of redness. Confirmatory evidences of tuberculosis, such as pulmonary signs and a fistula in ano, may be found upon careful search.

Syphilis.—Syphilis frequently attacks the rectum. Like tuberculosis, the symptoms are those of chronic proctitis. The mucosa exhibits multiple irregular ulcerations, which have a tendency to induce scar tissue formation subsequent to destruction of the mucosa.

The rectum thus appears uneven and irregular, with furrows, elevations and ulcerations in the more advanced cases; actual fibrous stricture is a fairly common sequel. Complications such as fissures, fistula and perirectal abscesses occur. The chief difficulty in diagnosis is to differentiate it from tuberculosis. The history, general examination and Wassermann reaction usually establish the true character of the affection; in questionable cases, scrapings from the ulcerations may be examined for acid-fast bacilli or spirochetes.

Gumma of the rectum is a rarity. A primary chancre is found in the rectum infrequently. It has the usual characteristics. Mucous patches may also be observed.

Actinomycosis.—This is an exceptional affection of the rectum, requiring differentiation from the foregoing granulomata. Detection of the ray-fungus in the discharge or scrapings is essential to diagnosis. It is found in adults, first appearing as multiple nodules beneath the mucosa. Later in its course, ulcerations of the mucosa occur; the nodules increase in size, fuse, and form sinuses, which discharge a yellowish pus. The multiple nodules, sinus formation and the diffuse nodular thickening of the mucosa and submucosa are very suggestive. The rectum may be partially or almost completely surrounded by this affection. Cases of an almost complete stricture have been reported.

Hemorrhoids

Hemorrhoids are of two varieties, external and internal, and are the most frequent of the surgical affections of the rectum. External hemorrhoids appear external to the sphincter and as soft or firm, rounded masses of the size of a pea or somewhat larger, which are covered by normal or slightly abraded skin. Internal hemorrhoids are situated above the sphincter, where they present as rounded, reddish or reddish-blue protuberances, usually multiple. The overlying mucosa may be smooth or ulcerated and bleeding. Internal hemorrhoids may only be found upon digital examination, or may be protruded so far through the sphincter muscle that a prolapse is very closely simulated.

The consistency of internal hemorrhoids varies, some of them being soft and moderately compressible, while others are firm. Often the accompanying ulcerations or proctitis make digital examination painful.

Patients complain chiefly of pain upon defecation, and burning pain following. Because of these symptoms and the frequency of tenesmus, there is a marked tendency to constipation. Protracted cases suffer from the symptoms and sequelæ of chronic proctitis.

Bleeding from the rectum occurs during or after defecation, and often contributes more to the mental distress of the patient than do the other local symptoms. The individual amounts of blood lost are usually small but, when continued over a long period, secondary anemia of some degree will ensue.

Prolapse

In prolapse of the rectum, the mucosa alone, or all the coats of that structure are protruded through the anal sphincter. The protrusion usually takes place during defecation and is frequently excited by local conditions such as hemorrhoids, proctitis and tumors, or may be symptomatic in cystitis, bladder calculus and enlargement of the prostate. Prolapse occurs mostly in children, in whom it should always suggest vesical calculus, although more often it is idiopathic.

A prolapsed rectum appears as a conical or somewhat cylindric mass protruding from the anus, of reddish or reddish-blue color, with a smooth or ulcerated surface. At the summit or apex of the mass is the opening of the rectal canal. This may be obscured by swelling or strangulation of the mass.

Another point to be observed is the direct continuity of the surrounding skin and the mucosa of the prolapsus. In intussusception, a sulcus exists at the junction of the two, allowing the finger to be inserted between the rectal and anal wall.

Foreign Bodies

Foreign bodies gain access to the rectum by intentional acts or accidental means. Articles swallowed may become lodged in the rectum, and fecal impactions and enteroliths may be found in the ampulla. The symptoms produced by foreign bodies are similar to those of acute and chronic proctitis. The chief complications are ulceration, perforation and abscess formation. Diagnosis may be made by palpation and proctoscopic examination. Impactions and enteroliths may produce pressure or obstructive symptoms.

Stricture

This condition is an aftermath of certain types of chronic inflammatory processes. Thus, it may be the result of ulcerative conditions which occur in chronic proctitis, or it may develop upon a specific infective process, such as tuberculosis or syphilis. Strictures are most common during and after the third decade of life, and syphilitic strictures are by far more frequent in women.

The history is of chronic proctitis of long duration. Following these symptoms, there is a period marked by increasing difficulty in defecation, and obstinate constipation. The stools may change in shape, becoming flattened or conical, or consisting of small masses; blood may escape from the rectum during defecation, due to coexisting ulceration.

Upon visual examination, a rectal stricture appears as an encircling or somewhat diffuse area of whitened, thickened scar tissue. The cicatrization is often irregular, presenting ridges and pockets, which may be the sites of ulceration. The stricture is usually situated low down in the rectum and the mucosa below it exhibits the signs of chronic proctitis. Occasionally, a stricture is met with near the rectosigmoidal junction, and is then not accessible to digital examination.

Upon palpation, with the finger, a rectal stricture presents as a narrowed or somewhat extensive, encircling band of dense, firm, unyielding tissue, usually with a smooth surface devoid of, or scantily covered by, mucous membrane; although the surface may be somewhat roughened, because of irregular cicatrization, it is never nodular in the purely inflammatory types of stricture. In general, the stricture is of a modified conical shape, so that increasing resistance is encountered as the finger is advanced, and a point is reached where the stricture firmly grasps the finger and prevents its progression. This same sign, which is of diagnostic import, may be obtained with graduated sounds or bougies. In fact, the apex of the stricture may be so small that digital exploration is not feasible, diagnosis being made by proctoscopy and instrumentation.

While rectal strictures are principally the result of protracted inflammation, leading to scar tissue formation, other possible causes must be recalled. Important in this respect is the reduction of lumen secondary to rectal malignancy, especially carcinoma and less frequently to benign tumors. Also, as with other hollow viscera, the stricture may be produced by extrinsic causes, such as dense chronic inflammatory or tuberculous adhesions in the pelvis; prostatic enlargements and tumors of the female genitalia; and pelvic and perirectal abscesses. Infrequent causes are penetrating wounds, caustic solutions accidentally used, and diverticulitis.

Pruritus Ani

Pruritus ani denotes a chronic irritation of the anal canal and the skin about the anus, characterized by severe itching. Pruritus is particularly common in old people, in whom it may be symptomatic of diabetes, renal disease, gout or rheumatism. The skin appears pale or whitened, is thickened, and may be smooth and glazed, or somewhat roughened with minute papillary hypertrophies. When grasped between the fingers it gives a "parchment" sensation and cracks readily.

Pruritus is always an indication of some other condition. In addition to the

constitutional diseases mentioned, it frequently depends upon some disease of the rectum or anus, particularly one in which there is a discharge. These causes embrace ulcers, fissures, hemorrhoids, proctitis, fistula, syphilis and tuberculosis. In these conditions, the appearance is one of irritation and inflammation, the skin being red, thickened and excoriated.

Diverticulum

A diverticulum is rarely found in conjunction with the rectum. Impaction of feces and intermittent, inflammatory attacks cause the formation of a mass lateral to the rectum, and produce symptoms of partial obstruction. The sense of fullness, pain, and difficulty upon defecation in an individual of middle age combine to suggest malignancy, and this supposition may be strengthened by the palpation of an irregular, hard and fixed mass. Proctoscopic examination is of the greatest importance in diagnosis. At times, the distal end of the diverticulum perforates, and a fistula of the perianal region is formed.

Ulcerations

Ulcerations of the rectum arise from injuries, inflammatory conditions, and specific and general diseases.

Traumatic ulceration may be caused by sharp articles or instruments which are forced through the anal canal; foreign bodies lodged within the rectum; or by the passage of hardened feces. Such ulcerations may be single or multiple, linear or irregular. They are painful, and usually bleed easily, presenting a clean, red surface with a granulating base.

In acute and chronic proctitis and dysentery, rectal ulcerations are common. In the milder forms the ulcers are multiple, superficial and small, and are either covered with mucopurulent material or are clean and bleeding. They have no characteristic contour. In the severe types, the ulcerations are deeper, usually somewhat irregular, and the edges are somewhat undermined, with sloughing of the tissue at the bases. They are extremely painful. In chronic proctitis, along with the ulcerations, a polypoid condition of the rectum is common.

Portal congestion is a source of rectal ulceration. The ulcers are multiple, usually not deep, and are associated with local and more remote evidences of portal obstruction—hemorrhoids; congestion, discoloration and edema of the rectal mucosa; ascites; enlarged or atrophic liver; and related signs.

Tuberculous Ulceration.—See "Tuberculosis of Rectum."

Syphilitic Ulceration.—See "Syphilis of Rectum."

Actinomycotic Ulceration.—See "Actinomycosis of the Rectum."

Chancroidal ulcerations are multiple, irregular, acutely destructive, with an evident undermining, deep crater with soft edges, and a purulent, sloughing base. There is considerable pain, and the inguinal nodes may be enlarged and tender. Chancroid is most common about the anus and adjacent skin, but may be found within the rectum. In the former situation, the ulceration may become chronic, involving a wide area of the perineum, genitalia and, sometimes, even the anterior abdominal wall.

General diseases, such as nephritis and diabetes, are occasionally the basis of rectal ulcerations.

Hysteria

(*Neurosis*)

In neurotics and psychoneurotics, so-called hysterical manifestations may be observed, these being rectal conditions without tangible pathologic foundation. Two types are generally described. The sensitive type is characterized by sensations of pain within the rectum; spasm of the associated muscles; and circumscribed by paresthesia of the rectal mucosa. Needless to say, all possible affections must be carefully sought for, before styling the condition as neurosis.

The insensitive type consists of a decreased sensibility of the rectum perhaps with a delayed sphincteric reflex, also. The result is marked constipation, because of the large amount of fecal material which accumulates in the rectum before the desire for defecation arises.

Condylomata

Condylomata are fairly common about the anus. (1) Broad condylomata are of syphilitic origin. They first appear as reddish papules. These later increase in size, are broad and flat, have a whitish or "bacony" appearance, and are covered with soft, moistened epithelium. (2) Condylomata acuminata, or elevated condylomata, occur in patches of warty or papillary growths, bathed in a foul secretion, and covered by thin, watery epithelium. A chronic discharge from the rectum or vagina is practically always associated.

Tumors

Benign.—Polypus is used as a general term applicable to benign pedunculated tumors of the rectum, regardless of their histology. All of the below-mentioned tumors may be classified clinically as "polypi." Chronic inflammation may give rise to polypus formation or hypertrophy of the follicles; and, conversely, the presence of a polypus often excites proctitis and ulceration of the mucosa.

Polypus.—In general, a polypus is usually a small, rounded or pendulous tumor, attached to the mucosa by a pedicle, and of firm or soft consistency. They may be either single or multiple. The tumor is covered by a normal or pale mucosa, or may present a deep reddish or purplish color. In fact, the general appearance is best likened to that of a cherry, although it may be larger and of different color and consistency. The symptoms produced by a polypus include painful defecation, sense of fullness, tenesmus, bleeding, discharge, proctitis and ulcer or fissure formation. The polypus may protrude from the anus after defecation. Obstruction is rare. Polypi occur both in children and adults.

Adenoma.—The adenoma is the most common benign rectal tumor, occurring especially frequently in children. It usually occurs singly on the posterior rectal wall, appearing as a pedunculated or rounded tumor; soft, firm, or cystic to the feel; rarely larger than a cherry; and freely movable. Recurrence is common. In adults, malignant degeneration sometimes occurs, such a happening being indi-

cated clinically by rapid advancement, fixity of the tumor, and induration at its base.

Papilloma.—Rectal papillomata occur in adults and old age. They form single or multiple tumors—rarely more than three—which protrude into the lumen of the rectum in a pedunculated fashion, presenting as soft villous tumors. They often bleed.

Fibroma is unusual. It has the common features of a polypus, and is of firm consistency. Bleeding does not take place. Myomata are very similar to the fibromata.

Lipoma is uncommon. When it is present, it arises from the fatty tags appended to the upper rectum, and forms a small or large pelvic tumor. Occasionally, however, it protrudes into the rectum, beneath the mucosa, appearing soft, lobulated and pedunculated.

Chondroma varies from the above, in that it is harder, more irregular, and is situated beneath the mucosa, without pedunculation. It is very rare.

Angioma of the rectum is very uncommon. It presents as a flattened, irregular, reddish or purplish mass in which tortuous, dilated vessels may be visible.

The *myxoma* is also uncommon. It occurs as single or multiple polypi, small or large, has a well-marked pedicle, and is very soft or cystic. It sometimes undergoes sarcomatous change.

A *pilonidal* cyst is very rare as a primary affection of the rectum. Secondarily, the rectum may be involved by such a cyst of the sacral or coccygeal region. The symptoms are those of a benign tumor, and the pilonidal cyst may only be suspected providing hair is protruded from the anus after defecation, or a bony fragment is palpated within the tumor. A pilonidal cyst may be congenital, or appear at any subsequent age, and varies in size, the smallest being that of a walnut. It is found in the midline of the back over lower sacral region. It rarely involves the rectum.

Sebaceous cysts arise in the skin about the anus. They present as single, small, rounded tumors, attached to the skin at a single point, and firm or soft in consistency.

Malignant tumors of the rectum include carcinoma, sarcoma, and endothelioma. Carcinoma of the anus appears as an *epithelioma* of lesser or greater extent. It frequently begins in some chronic lesion such as an ulcer, a fissure or a previously benign tumor. Its presence is indicated by an elevated, irregular, warty or nodular growth, which has rather indefinite boundaries, and which may exhibit an ulceration with indurated edges. Metastasis takes place in the inguinal nodes.

Intrarectal carcinomata include scirrhus, medullary and adenocarcinomatous types, all of which occur principally as primary growths. The male sex is much more frequently affected than the female. The course is less rapid in the scirrhus type.

A frequent early symptom is a feeling of fullness and weight in the rectum. Difficult defecation and pain are observed later, together with a discharge of mucus, pus and sometimes blood. There is usually marked constipation, with intermittent diarrhea. Pain, instead of being localized to the rectum, is often referred to the perineum, or thighs, and sciatica may be the presenting symptom.

In some cases, hemorrhage is profuse. In the scirrhus carcinoma, a rectal stricture is formed by malignant infiltration, and this frequently occasions attacks

of partial intestinal obstruction. Metastases occur in the inguinal and pelvic nodes, and adjacent pelvic organs may be involved by extension.

Upon visual examination, a medullary carcinoma appears usually on the lateral or posterior rectal wall, as a protruding, elevated and irregular mass. On palpation, it is soft, and friable, bleeds easily and its indurated base invades surrounding tissues. This form of carcinoma is not likely to produce a stricture, but progresses rapidly, metastasizes fairly early, and causes frequent bleeding.

The adenocarcinoma is very similar in its course, and general appearance. Ulceration is common and the consistency may be either firm or soft. Scirrhus carcinoma is the type which frequently grows in an encircling manner, and produces a malignant stricture of the rectum. It is extremely hard upon palpation, is irregular and nodular, and diffuses through the rectal and perirectal tissues in such a manner that the affected portion is transformed into a firm, rigid tube, which may not admit even the tip of the finger. This is the type which causes intestinal obstruction, and which alters the shape and size of the stools, producing "ribbon" and "tapeworm" stools, and those resembling stools of various animals.

Sarcomata occur at an earlier age than carcinomata, are not frequent and may be either primary or secondary. Sarcoma sometimes is found in children. Any variety may be found. The early symptoms are like those of carcinoma—a sense of rectal fullness, and difficult defecation. Pain and bleeding are relatively late. Diarrhea and a mucopurulent discharge occur as with carcinoma. There is no stenosing tendency, but intestinal obstruction often takes place, because of the rapid increase in the size of the tumor. Metastases are found in the inguinal regions and in the liver. A sarcoma of the rectum is usually within easy reach of the examining finger. In the first stages, it is entirely covered by mucosa, and appears as a fairly smooth and regular mass, either pedunculated or rounded, and either firm or soft in consistency. Later, the mucosa is fixed to the underlying mass, becomes ulcerated and bleeds easily, and there is marked tenderness, together with rapid increase in the size of the tumor.

Endothelioma of the rectum is a pathologic rarity.

CHAPTER XXI

INTESTINAL OBSTRUCTION

Of all the intra-abdominal conditions which confront the surgeon, there are none which are of more importance, both from the standpoint of diagnosis and of treatment, than cases of intestinal obstruction, whether of the acute or chronic type. Recognition of the acute forms demanding immediate surgery results in life-saving operations. The detection of the chronic forms due to pathologic changes in intra-abdominal anatomy may perhaps forestall the necessity of radical surgery or prevent the severe series of symptoms so often found in the acute obstructions. Clinically, we speak of the acute and chronic obstruction. Pathologically, we recognize mechanical or dynamic ileus; paralytic or adynamic ileus.

The acute cases form a dramatic and vivid series, testing the ability of both physician and surgeon and reaching the pinnacle of operative mortality among intra-abdominal lesions. This mortality can be justly attributed to one glaring fault—delay in diagnosis. Hence, familiarity with the presenting symptoms, and intelligent interpretation of the same, must be urged upon all.

The chronic cases, while less spectacular in the main, are none the less important, as most of them are progressive, bearing in mind that acute complete obstruction frequently occurs in the presence of a chronic partial occlusion, changing entirely the clinical aspect of the case and obscuring accurate diagnosis.

Mechanical Ileus.—By mechanical or dynamic ileus is meant an obstruction of the intestinal tract due to demonstrable physical agencies. Thus, if fibrous adhesions or bands pull upon or bind or compress a portion of the gut, the resulting occlusion is purely mechanical. In similar fashion an intra-intestinal tumor causes dynamic ileus by reducing the caliber of the gut, even as may an extra-intestinal tumor, by its weight and position. In mechanical obstruction, then, there is a violation of the physical laws of the alimentary tract by a new and pathologic force, itself physical and tangible, which exerts its action solely in a mechanical manner. The consequent reflex is stimulation of peristaltic activity, nature endeavoring to surmount the offending obstacle by a display of antagonistic force. This peristalsis is proportionate to the duration of the obstruction in acute cases, increasing to a maximum as time advances. Muscular fatigue eventually occurs and there is cessation of intestinal movements, and the absence of gurgling sounds. Hence, in late stages, the picture has shifted from that of mechanical obstruction to one of reflex or pseudoparalytic ileus.

Paralytic Ileus.—Paralytic, reflex or adynamic ileus consists of an atonic condition of the bowel induced reflexly by nerve trauma or irritative or inflammatory processes. The commonest basis is an acute peritonitis of some variety, such as that accompanying acute appendical or gall-bladder troubles, and visceral perforations. It also follows severe trauma to the abdomen, and is a symptomatic occurrence in

such conditions as twisted ovarian cyst, acute pancreatitis and the like. Perhaps the best known example of paralytic ileus is that which occurs postoperatively. Here the ileus is apparently independent of the type of abdominal operation, and it may be seen following the simpler ones as well as after those more complicated.

The symptoms comprise repeated vomiting, progressive abdominal distention, toxemia, and absence of passage of feces and gas.

In this affection, contrasting it with mechanical ileus, a flaccid, atonic and relaxed condition of the bowel wall occurs, and the tendency is toward further distention rather than being toward increased peristalsis. Mechanical and reflex ileus are not infrequently combined. Under such conditions peristaltic waves may be observed.

ACUTE INTESTINAL OBSTRUCTION

Acute intestinal obstruction is of sudden onset with intermittent, colicky pain which may be localized to a particular abdominal region at first, but which soon becomes diffused over the entire abdomen, or a large part of it.

Nausea and vomiting follow shortly, and the vomiting, rather than being an initial symptom, is recurrent and progressive. The first vomitus consists of stomach contents. Later, it becomes bilious, and, if the obstruction is unrelieved, fecal material appears. Yet, in a high obstruction of the gut, fecal vomiting does not occur until late in the condition. It is accompanied by great retching and straining; these features contribute to the distress and impair the strength of the patient. Fecal vomiting, the pathognomonic sign of intestinal obstruction, is a late one, and in the majority of patients does not appear until the thirty-sixth to forty-eighth hour. Thus, it should be our aim to reach the proper diagnosis before this most alarming symptom presents.

Constipation, or coprostasis, is one of the cardinal symptoms. Many patients will state that they are positive a good bowel movement would relieve their symptoms.

Absolute constipation may not be apparent during the early hours of the affection, as the bowel, below the site of obstruction, may be emptied voluntarily or by enemata. When repeated enemata fail to produce results of feces or gas, and the abdominal distention persists or increases, intestinal obstruction exists, whether it be of a primary nature, or the result of peritoneal irritation or other factors. No arbitrary rule can be established whereby one can be certain that there is an obstruction but, if two or three enemata return clear, this diagnosis is compulsory. In partial obstruction, as by impacted feces, the patient usually can pass flatus, and gas returns with the enema. While constipation is the rule, diarrhea may occur in some cases of obstruction (especially in intussusception), and blood may be passed per rectum.

Pain, at the onset, is usually of a colicky, intermittent character, and may be referred directly to the site of the obstruction. It is more likely to be diffuse, however, and as the gut becomes fatigued by its constant attempts to overcome the obstruction, the pain becomes sharper and continuous, acute exacerbations often occurring as violent peristalsis above the obstructed area takes place. The site of original or most severe pain is an accurate guide to the underlying site of obstruction in some instances, but is not to be depended upon as such. Occasionally,

instead of being colicky, the pain is sharp and constant from the start, mimicking in its location, radiation and characteristics the pain of various abdominal affections, such as an appendicitis or twisted ovarian cyst.

In the early stages, pressure upon the abdomen or lying in the prone position relieves the pain somewhat, and the patient often attempts these methods, or lies on the side with thighs flexed upon the abdomen.

Distention is not an early symptom, although it is appreciable to some extent within a few hours, and progressive distention is most significant, especially in conjunction with repeated vomiting and relative or absolute constipation. The area and extent of distention vary with the portion of gut which is obstructed, and hence are clues thereto. If the obstruction is high up, as in the duodenum or jejunum, only the upper and central portion of the abdomen will be distended and tympanitic, gastric dilatation comprising most of the tympanitic area. When the lower ileum is obstructed, the distention embraces most of the abdomen, but the flanks are not prominent, the colon and sigmoid being collapsed.

Obstruction in the colon or sigmoid, on the other hand, will produce a generalized or asymmetrical distention in which the prominent flanks play the chief part. The advancing abdominal enlargement is usually visible, but may be accurately determined by mensuration.

Visible peristalsis, with few exceptions, especially through a fat abdominal wall, means intestinal obstruction. It is a sign of mechanical ileus, being absent in the paralytic variety in which atonic conditions, rather than increased muscular excitability, prevail. It may be confined to a limited area, or be somewhat scattered, and may travel in the usual direction or be reversed. Groupings of the intestinal coils and patterns are frequently seen, and inform the observer of the approximate location of the obstruction. This is especially true of the "step-ladder" type of intestinal patterns.

It is said that the intensity of visible peristalsis is in direct proportion to the duration of the affection, but it is to be recalled that this sign is absent in late cases, in which inertia or atony supervenes, subsequent to the unusual activities of the bowel.

Light conditions and the thickness of the abdominal wall likewise modify the observance of this most valuable sign. It is, of course, best seen in thin persons. Gurgling sounds and noises may be heard over the abdomen—and are often audible at some distance—as long as peristalsis exists.

General Symptoms.—At the onset, the general condition is but little affected. The pulse is usually about normal, and the temperature may be subnormal. The pulse remains at a low level rate, when it is likely to rise suddenly, becoming rapid and weak, as the heart and lungs are embarrassed in their functions, and the toxemia becomes more marked.

During the intermediate period, the temperature frequently rises a degree or more, but is not very high unless peritonitis is present. The patient appears ill throughout, after the incidence of vomiting. This appearance is enhanced by the accompanying retching in the early phase as well as by the effortless, bulky vomiting of the later stage, and becomes more and more evident as the distention increases and dyspnea and cyanosis develop. The general features of the neglected cases are those of peritonitis. Thirst, dry tongue, foul breath and scanty urine are to be

observed. The urine often contains albumin and casts. A moderate leukocytosis is quite common.

Diagnosis.—The description of acute intestinal obstruction usually given is that of the late stage, consisting of a tremendously distended abdomen with dyspnea, thoracic breathing, rapid pulse, toxemia, repeated brownish, fecal vomiting, coprostasis and visible peristalsis. In the presence of these, the diagnosis could hardly be escaped, and it is to be regretted that this clinical picture has been so emphasized, excepting when presented as an avoidable state, which the average patient should not be allowed to reach.

In other words, to be of value, diagnosis should be made early. This is not an easy matter, and at the onset, calls for a nicety of judgment or good fortune beyond the common lot. Within a few hours suggestive symptoms are present, and the diagnosis, in justice to the patient, should be made on this basis—on suspicion, as it were—for the unmistakable combination of fecal vomiting and marked distention is relatively late. Reliance, then, must be placed largely upon the occurrence of repeated vomiting and the effect of enemata.

If the latter are ineffectual, vomiting is progressive and there is some distention, an ileus of some type is present. If peristaltic waves are seen traversing the abdomen, the diagnosis is confirmed. Fecal vomiting, while constituting the evidence, *par excellence*, of intestinal obstruction, is all too frequently the evidence of neglect as well. A careful and thorough history and physical examination are essential.

Once having determined that there is an obstruction, an attempt should be made to decide upon three other points: (1) Is the obstruction primary or symptomatic; that is, is there a mechanical or paralytic ileus? (2) Where is the probable location of the pathologic process and what is the most logical presumptive cause?

Comment.—1. The presence or absence of visible peristalsis is, in general, the best key to the nature of the obstruction, from a purely physical standpoint. It is most marked in complete obstruction as by encircling bands, and is absent in postoperative ileus, unless newly formed adhesions or kinking contribute to the obstruction. The sign may not be present at the onset, hence the importance of repeated examinations. As has been noted, it may not be found in delayed cases, because of a secondary atony of the intestine. That a palpable tumor indicates mechanical obstruction, for the most part, is self-evident, but its action must not be misconstrued. For instance, a reflex atony is occasionally seen when the pedicle of a tumor, such as an ovarian cyst, undergoes torsion.

If an accompanying disease is present in a recognizable form, its character will suggest the type of ileus. For instance, marked abdominal distention and constipation in a case of pelvic peritonitis intimate that the intestinal coils are in all probability bound down by adhesions, and the same inference will be made in a case of tuberculous peritonitis. With a large ovarian cyst or hydronephrosis, the intestinal lumen is decreased by mechanical pressure, but in acute pancreatitis or cholecystitis or appendicitis, the intestinal symptoms are symptomatic.

2. The probable location of the obstruction may be inferred from the history, the character of the vomitus, the abdominal distention, and by abdominal and pelvic examination. Thus, the history of a pelvic peritonitis suggests that the pelvic coils of the ileum or the sigmoid are involved. The history of previous surgery

suggests the formerly diseased area as the obstructed site, or adhesions binding a loop of gut to the laparotomy scar. The significance of the distribution of distention has been explained. The most distended and prominent coil of a "step-ladder" pattern lies nearest the obstruction, as does a tumor mass, in most cases.

The character of the vomitus is only of localizing value in cases which have not had fecal vomiting after many hours, or in which the physical signs point to blocking of the duodenum or proximal jejunum. Rapid development of this phenomenon usually signifies that the ileum is affected, while it may be markedly delayed or may never appear in low obstructions of the large intestine.

Pelvic examination demonstrates the presence or absence of a mass in relation to the pelvic organs themselves, the rectum or sigmoid, or detects the presence of sagging coils of the ileum beyond the point of obstruction.

The history of change in shape and size of the stools points to the rectum or adjacent sigmoid, while tarry or bright red blood in the stools suggests the relatively high or low intestinal site.

Initial severe collapse usually indicates a high obstruction, but is also marked where strangulation of the blood-vessels complicates the occlusion of the intestinal lumen, as in volvulus and intussusception.

Peristaltic waves often travel toward the obstructed site and end at that point. Likewise the area of greatest pain often coincides with the area of occlusion.

A specific diagnosis may be impossible, yet a presumptive one should always be made. This will depend upon the data accumulated in regard to all the details of history and physical examination aided by the past experience and general knowledge of the examiner. To this purpose the following more common causes of mechanical obstruction with their peculiarities are considered.

Mechanical Obstruction

Inflammatory processes { infective
chemical
traumatic (postoperative)

Bands and adhesions { tuberculosis
congenital

Postoperative

Strangulation (any type of hernia with peritoneal sac, external or internal)

Intussusception

Volvulus

Tumors { by pressure of intra-abdominal tumors from without the gut
See "Tumors of Small and Large Intestine."

Congenital anomalies { Meckel's diverticulum
anomalies of duodenum
megacolon (Hirschsprung's disease)

Foreign bodies { any large ingested material
enteroliths

Cicatrices { chronic enteritis
chronic colitis
tuberculous enteritis or colitis

Bands and adhesions are the most frequent causes of obstruction and are seen especially up to the age of forty-five. The bands may be of congenital origin or the sequelæ of inflammatory processes. While adhesions result from some type of peritoneal irritation, infectious in nature, they are often postoperative and occasionally of a tuberculous or of malignant origin.

This type of obstruction may come on acutely and without premonitory signs, or as is usually the case, the patient gives the history of chronic constipation which has gradually become more marked, or of recurrent attacks of partial obstruction, or of preceding pelvic or other regional peritonitis.

Following the acute or subacute onset, one is very likely to observe peristaltic waves, and intestinal patterns are fairly common in obstruction by adhesions. When the gut is strangulated by a single band or a loop is kinked over a band, the onset is very sudden and the pain is often confined to a small area.

Later, as peristaltic activity becomes well established, the pain is more diffuse but is frequently more marked locally. When muscular spasm and pressure tenderness are elicited in some one area—and this is not a rarity—the resemblance to an inflammatory lesion is noteworthy, especially when the local signs are at or near one of the points of diagnostic significance such as McBurney's, and there are associated moderate changes in the temperature and the leukocyte count. The subsequent course differentiates the various possibilities. The portion of gut most frequently obstructed by bands and adhesions is the lower ileum.

Strangulation.—Strangulation of the gut may be (1) external or (2) internal. External strangulation affects a portion of gut which has made its way through one of the abdominal rings or an abnormal separation of muscle-fibers and fasciæ, and is a strangulated hernia. Internal strangulation may effect an intra-abdominal hernia, or may be produced by bands, adhesions or apertures.

The symptoms of strangulated external hernia are well known and need no amplification. The condition is most common in the elderly. The diagnosis depends upon the symptoms of intestinal obstruction and the recognition of an irreducible tender mass at one of the usual hernia sites, or at any other point in the abdominal wall.

The symptoms of internal strangulation are similar to those described under "Bands and Adhesions." Strangulation by bands is found especially along the lower ileum, while a true internal hernia develops particularly about the cecal and duodenojejunal regions where there exist recesses or fossæ. Occasionally, a strangulated external hernia is reduced *en masse*, the strangulation itself not being relieved. In such an event, the obstructive symptoms persist, an internal strangulation having been produced by the manipulation.

Intussusception arises most commonly in infants, although occasionally an invagination of the intestine develops from the presence of an intra-intestinal tumor, especially a benign one, at other periods of life. Nevertheless, intussusception is the most frequent cause of acute intestinal obstruction during *infancy*, and thus assumes the front rank in the differential diagnosis of such cases.

The onset is sudden, with abdominal pain and vomiting. Instead of constipation, diarrhea may prevail, and should be fully as suggestive, especially if there is blood in the stools. This occurs when the obstruction is incomplete, a narrowed lumen being preserved within the center of the intussusception, through which

liquid feces make their way. In this type of case fecal vomiting is markedly delayed. Upon physical examination, the abdomen is found somewhat distended and tympanitic, rigidity not being marked.

Palpation of an elongated, "sausage-shaped" tumor in any abdominal quadrant is conclusive, but it cannot be overemphasized that the mass may only be felt per rectum. The intussusception is usually ileocecal, the tumor then being palpated in the right lower quadrant. Peristaltic waves may or may not be observed.

Constipation or bloody diarrhea, distention, repeated vomiting and a palpable tumor mass are the principal elements in diagnosis.

Differential Diagnosis.—Acute gastro-enteritis in infancy must be differentiated. The chief factors are the absence of a tumor, and the presence of frequent, watery, greenish stools; an accompanying acidosis can usually be demonstrated. The history of dietary error is almost invariable.

Cases of acute infectious diarrhea more closely resemble intussusception, the stools being blood-tinged. Absolute differentiation may rest upon the presence or absence of a tumor, but it is usually not difficult.

Rectal Prolapse.—An intussusception may protrude through the rectum, simulating a true prolapse. After reduction of the "prolapse," however, the mass can yet be felt by the palpating finger within the rectum.

Tumors are most common in the large intestine and the lower ileum. Both benign and malignant forms arise, and are more fully discussed under "Affections of the Intestines." The symptoms are either those of intestinal stenosis or ulceration, or both. The tumor may or may not be palpable. With a sagging mesentery, its location may vary from time to time. The earliest symptoms are vague and indefinite, and in any tumor or suspected tumor, examination should always embrace the inguinal nodes, the rectum, the liver and the abdominal walls.

A metastatic nodule of the umbilicus frequently precedes definite signs of a malignant intra-intestinal tumor, or an irregular hepatic margin denotes the nature of a tumor palpable elsewhere. Also, a "*rectal shelf*" or *perirectal infiltration* may be the only sign of malignancy higher up in the intestinal tract, and is diagnostic. The importance of radiographic study is obvious, and should include both fluoroscopy and negatives.

Volvulus is most frequent about the age of forty, and occurs more often in males. The sigmoid is the most frequent site, so that acute pain in the lower left quadrant or to the left of the umbilicus is the most common mode of onset. Combined with this symptom is some degree of shock, as in most instances of acute obstruction, especially where there is immediate interference with the circulatory mechanism. Distention will probably be asymmetrical, and a mass may be palpated in the left lower quadrant. Fecal vomiting, obviously, is not early, and in fact is infrequent.

Occasionally, volvulus arises in conjunction with an abnormally long cecal mesentery, and the signs and symptoms are then referred to the lower right quadrant. Peristaltic waves are usually present, and the distention is much more marked and more rapid than in obstructions of the small intestine. The immensely dilated colon may be easily mapped out in some cases, the central portion of the abdomen being less distended. Enemata are apt to be ineffectual from the very onset. Tenesmus, however, is a frequent and painful symptom.

Congenital anomalies produce obstruction shortly after birth or many years later. Congenital stenosis of the intestine is rare, affecting chiefly the duodenum, and is characterized by persistent recurrent vomiting and rapid emaciation. Imperforate anus and congenital absence of the rectum are evidenced by absence of bowel movements after birth, and their particular physical signs. *Meckel's diverticulum* occasionally produces intestinal obstruction, usually in adult life, a band extending from it to the neighboring intestine or abdominal wall. The fibrous remains of the omphalomesenteric duct may encircle or kink the gut.

Similarly other congenital bands may cause an obstruction, and congenital anomalies are often the basis for such occurrences as volvulus and internal hernia; an infrequent cause of chronic intestinal obstruction is congenital dilatation of the colon, or *Hirschsprung's disease*.

Excepting those conditions which are evident at birth, the presence of a congenital anomaly is not easily determined clinically. Usually it is inferred rather than asserted, the presumption of an abnormality being made when the ultimate diagnosis is known.

Foreign bodies of sufficient size to effect intestinal obstruction are not commonly encountered. Included among foreign bodies are ingested materials, such as fruit pits, gall-stones, and enteroliths. Insane or perverted people sometimes swallow various sorts of objects. The symptoms are of acute or chronic obstruction. When large, the foreign body may be felt as a "tumor," especially in the cecum or sigmoid. The history of previous gall-stone colic is considered suggestive of occlusion of the intestine by a stone from the biliary passages.

CHRONIC INTESTINAL OBSTRUCTION

Chronic intestinal obstruction practically always develops on a mechanical basis, so that one does not have to exclude purely reflex conditions, excepting in so far as their prior occurrence might account for the presenting symptoms. The symptomatology depends upon the site and cause of obstruction, and also upon the changes in the intestine above and below the area affected. Acute symptoms often arise, the essentially chronic nature being revealed only by the history. In many patients, the most prolonged symptom is constipation, this being more significant if it gradually becomes more pronounced.

Alternate constipation and diarrhea may be of equal significance. Flatulence and bloating of the abdomen accompany intermittent attacks of partial obstruction.

While gastro-intestinal symptoms predominate, anemia, loss of weight, signs of "auto-intoxication" and various neurotic manifestations complicate advanced cases. Conversely, neurotics and hysterical subjects, in rare instances exhibit the signs and symptoms of a chronic intestinal obstruction, and it may be impossible to rule out mechanical ileus, even though the nervous tendency of the patient and hysterical antecedents are well recognized.

Pain is not a marked symptom until the case is well advanced. When present it may be colicky in character, or more often in early cases, amounts only to a sense of distress and fullness, either with or without relation to eating.

The stools are changed in shape only with rectal or low sigmoid occlusion. Constipation is the rule, but periodic diarrhea following constipation is frequent,

the stool containing mucus. Malignant and papillary intra-intestinal tumors cause the appearance of blood in the stools.

Chronic Obstruction of the Small Intestine

This may affect the duodenum, jejunum or ileum. When the duodenum is involved, the symptoms are those of pyloric stenosis—"indigestion," distress after eating, nausea and vomiting of material retained in the stomach. The physical signs to be observed are epigastric distention, peristaltic waves and splashing sounds with active palpation. There is constipation, of course, and in late stages impairment of nutrition. The most common causes are stenosing duodenal ulcer, malignancy in or about the duodenum, extra-intestinal tumors and adhesions. The stomach tube, fluoroscopy and radiography are important aids in diagnosis. Jaundice is an associated symptom in some cases.

In jejunal obstructions—which are uncommon—the signs and symptoms are very similar with the exception that gastric retention is not so marked. Vomiting is an early and frequent symptom, and consists of ingested material and bile.

The ileum, occupying as it does the central and lower portions of the abdomen and the pelvis, is the division of the small intestine most often chronically obstructed. The possible causes are almost without limitation yet, for practical purposes, the obstruction can usually be attributed to inflammatory or postoperative adhesions, bands, congenital anomalies and benign tumors. Extra-intestinal tumors, time and again, partially occlude the ileum by pressure, adherence or infiltration. The first symptoms are constipation and a sense of fullness throughout the central portion of the abdomen. Actual pain does not usually manifest itself until attacks of partial obstruction occur; at such times the abdomen is distended, the patient experiences crampy pains, and there is repeated vomiting. The vomiting is not fecal in these instances of partial occlusion and the symptoms subside following the use of enemata or cathartics. Peristaltic waves are commonly seen during the attack, and the intestines frequently assume groupings or patterns. Peristalsis may also be observed in the intervals, but is not a constant sign.

Deep typhoid ulcerations during the active stage of the disease account for some cases of ileal obstruction by stricture, while others are due to tuberculosis or dysentery. The terminal ileum is subject to all the affections of the cecum, but its involvement is usually secondary.

Chronic Obstruction of the Large Intestine

The Cecum.—Obstruction at this site is most often due to periappendical adhesions, carcinoma or other tumors, or tuberculosis; less frequently to benign tumors, internal hernia, or actinomycosis. The signs and symptoms are similar to those of obstruction of the lower ileum. In many instances a tumor mass is palpable in this region, and marks the limit of peristaltic waves, if such are present. Vomiting is much less pronounced than in higher obstructions, but pain and a sense of fullness are pronounced, distention is usually greater, and visible peristalsis is more frequently observed. The dilated cecum often forms a visible and palpable mass in the right lower quadrant. In considering possible causes it should be recalled that foreign bodies are very likely to become lodged in the cecum.

The Colon and Sigmoid.—The most common causes of chronic obstruction in the colon and sigmoid are benign and malignant tumors, stricture following ulceration, impacted feces, adhesions, and pressure by extra-intestinal tumors. Diverticulitis must also be considered. Volvulus of a chronic nature frequently affects the sigmoid, especially the splenic flexure of the colon. Megacolon is a rather infrequent cause. Here again, vomiting is a delayed symptom, but abdominal distress and distention are common, and constipation is annoying. One or both flanks are prominent and tympanitic, or the abdominal distention may be symmetrical. It is surprising how soon after eating the sense of fullness may develop, despite the remote position of the obstruction. These patients often complain of gas pains and audible gurgling sounds along the course of the colon.

Pressure of a dilated transverse colon upon the stomach frequently incites postprandial vomiting and other gastric symptoms, analogous to those of organic pyloric stenosis. When stomach lavage yields a large amount of gastric contents but fails to consistently reduce the tympanitic epigastric distention, obstruction of the colon should be suspected, and for purposes of confirmation, fluoroscopy, after the administration of a barium enema, is the most satisfactory.

Diagnosis of Chronic Obstruction.—Diagnosis of chronic obstruction can usually be made from the history and physical signs. Fluoroscopy and radiography are of great value in diagnosis, and such examinations should include both gastroenteric series as ordinarily performed, and radiography after a barium enema.

CHAPTER XXII

PANCREAS AND SPLEEN

AFFECTIONS OF THE PANCREAS

Inflammatory conditions	$\left\{ \begin{array}{l} \text{acute pancreatitis} \left\{ \begin{array}{l} \text{hemorrhagic} \\ \text{gangrenous} \\ \text{suppurative} \end{array} \right. \\ \text{abscess} \\ \text{chronic interstitial pancreatitis} \end{array} \right.$
Calculi	
Granulomata	$\left\{ \begin{array}{l} \text{tuberculosis} \\ \text{syphilis} \end{array} \right.$
Cysts	
Tumors	$\left\{ \begin{array}{l} \text{benign} \left\{ \begin{array}{l} \text{cystic adenoma} \\ \text{lymphadenoma} \end{array} \right. \\ \text{malignant} \left\{ \begin{array}{l} \text{sarcoma} \\ \text{carcinoma} \end{array} \right. \end{array} \right.$

The pancreas lies deep in the epigastrium, transversely across the spinal column, with its right extremity in the curve of the duodenum and the left or tail end extended toward the spleen. It is situated about 3 inches above the umbilicus about halfway between the umbilicus and the ensiform cartilage and at the level of the second lumbar vertebra. Because of its deep position and surroundings, a direct examination is seldom made.

Inspection is of no value unless the organ is greatly enlarged, when there will be a distinct change in the form of the epigastrium. Enormous enlargements will cause a bulging either near, or just above the umbilicus at the midline or just at the level. All such swellings are flattened out without distinct margins due to the overlying greater omentum and abdominal wall. Rarely does the swelling extend toward the pelvis and simulate an ovarian cyst. In rare cases it is valuable to place the patient in the Trendelenburg position with the pelvis raised; a pancreatic cyst will then move upward toward its point of origin.

Palpation of the pancreas should be made when the stomach and bowels are empty, the patient in the dorsal decubitus. When the patient breathes deeply the examiner should depress the abdominal wall in the epigastric region by steady firm pressure. If the pancreas is enlarged an indistinct mass will be made out lying deep in the epigastrium, transversely across the vertebræ. Pancreatic tenderness may be determined at *Desjardins' pancreatic point* which is situated about 6 centimeters above the umbilicus on a line drawn from the umbilicus toward the deepest part of the right axilla, the arm hanging at the side.

Percussion of the pancreas is seldom of value. If the pancreas is greatly

enlarged and if the patient has lost weight, an area of dulness may be found over the pancreas, surrounded by a tympanitic area caused by the stomach and intestines. In such a case, inflation of the stomach will cause the dulness to disappear.

Inflammatory Conditions

Acute Pancreatitis.—Reginald Fitz, recognizing the importance of the pancreas, an organ heretofore more or less neglected from the clinical standpoint, in an address before the New York Pathological Society in 1889, gave to the profession the most complete and comprehensive ideas regarding the inflammatory conditions of the pancreas which had hitherto been known. He divided the acute inflammatory changes into three groups: (1) Hemorrhagic, (2) gangrenous, and (3) suppurative.

In 1901, Opie's work appeared, and, after experimentally producing the disease, he expressed his opinion that the term acute hemorrhagic pancreatitis should be replaced by the name hemorrhagic necrosis, a term which could vividly describe the necrosis or death of the pancreatic parenchyma. His idea that the acute inflammatory diseases of the pancreas represent only the various stages of the same lesion has been substantiated by the more recent workers on this subject. Deaver, *from a clinical viewpoint*, believes that the disease should be divided and classified according to the severity of the symptoms, namely, (1) ultrasevere, (2) severe, and (3) subacute.

According to Fiske Jones's idea, the etiology of acute pancreatitis and that of acute hemorrhagic necrosis is so different as to necessitate a separate nomenclature for each. Recognizing the relation between the various stages of the same disease, whatever the etiology may be, it appears as though we were justified in following Deaver's classification, bearing in mind, however, the fact that, from a pathologic standpoint, Opie's suggestion of the term hemorrhagic necrosis is more scientific and more applicable, once the abdomen has been examined either at operation or at autopsy. The term acute pancreatitis may be used only when the disease is to be considered of hematogenous origin.

Frequency.—Landon reported that in twenty years at the Massachusetts General Hospital, only forty-two cases have been recorded. Meunch's statistics from the office of the Chief Medical Examiner of New York City shows that, of the 9,500 cases which went to autopsy, only twenty-one were caused by acute pancreatitis. Draper reports nineteen out of four thousand autopsies. Judd, Starr, and Lyons reported one case in 1922 at the Mayo Clinic. At the Albany Hospital, out of 16,160 operations performed within the past five years, only five have been operated upon, though two died at the hospital without operation.

Etiology.—Our medical and surgical conception of this disease must of necessity be based upon the determining factors which bring about the lesion. Indeed, the surgeon could plan his mode of procedure before, during, and after operation with more accuracy if he knew, with a certain amount of surety, the underlying cause. The pancreas is considered to be, in the vast majority of cases, the seat of the primary lesion, but, as Tuttle points out, "whether all of these diseased processes originate in the pancreas itself is still an open question."

Anatomicophysiology research, including a vast amount of animal experimenta-

tion, has been done to clarify the traditional mist of the pancreas. One fact, above all others, has been determined by all who have worked upon the problem, namely, that acute hemorrhagic necrosis (acute hemorrhagic pancreatitis) is due to an activation of the pancreatic ferments.

The search for knowledge of the factors which determine this activation has led to a most enthusiastic and painstaking series of experiments and, at the present time, due to the results of such experimentation supplemented by clinical findings, two definite schools of opinion have been formed. The first school believes that it is attributable to the entrance of the bile or other activating substances into the pancreas by means of the pancreatic duct; the other maintains that it is caused by a bacterial infection of the pancreas by means of the lymphatics.

On the other hand, McCrae suggests infection of the pancreas through the blood stream, basing his idea upon those cases of acute pancreatitis which follow in the course of the acute infectious cases. Fiske Jones, as noted in another part of this chapter, brings up the possibility of two different routes, and believes that there are two distinct varieties based upon etiology.

Symptomatology.—Probably due to the rarity of this condition, as compared with the frequent occurrence of so many of the acute abdominal diseases, the average physician or surgeon is likely to overlook a case of acute pancreatitis. If he has that condition in mind, he feels that the making of a tentative diagnosis is more or less of a "shot in the dark" proposition, and is loath to give utterance to it. It has been a tradition handed down by many medical and surgical collaborators that there is no definite mode in many cases and, indeed, in most of them, of making a preoperative diagnosis of an acute inflammation of the pancreas. Is it that these cases are so vague in their symptom-complex as to exclude the ordinary making of a diagnosis, as we would in cases of gall-stones or appendicitis; or is it, perhaps, that the condition does not enter our diagnostic head with sufficient frequency to register the probability of the existence of an acute inflammation of this organ? A shrewd and well-trained interne will very often suggest an acute pancreatitis, while his chief will be more or less prone to discourage him in making the diagnosis of a condition which is so unusual. We have seen this occurrence often, and we have in turn been culpable in discouraging the young doctor from thinking of the uncommon, rather than the common lesions.

There are few typical cases of any surgical condition, and certainly the inflammatory conditions of the pancreas affirm this statement; but if, recognizing the variance of signs and symptoms in certain cases, we take the clinical signs of acute pancreatitis as a whole, we may be more positive in a preoperative diagnosis than we are at the present time. A large number of case histories which have appeared in the literature have been reviewed and an endeavor has been made to make an analytic study of the symptoms. Not one single important clinical observation has been contributed to our knowledge of the disease since Reginald Fitz addressed the New York Pathological Society in 1889, with the exception of the occasional reference to the finding of glycosuria and the relation of the blood sugar index to the disease. Laboratory methods to determine the presence of this lesion have been tried out conscientiously and have, on the whole, failed.

In discussing the clinical aspect of this disease, Deaver's classification has been followed (clinically), namely, (1) ultrasevere, (2) severe, and (3) subacute.

ULTRASEVERE.—In the instances under this grouping, the most striking symptoms are those of *pain* and *shock*. The former is so terrific and agonizing as to cause the patient to “writhe in agony” (an expression repeatedly used in the history of cases); it is usually constant, with but little interval between the paroxysms, and is seldom controlled by morphin. The pain generally originates in the upper abdomen, most often in the epigastrium, radiating to the left or right of the median line and then gradually over the entire abdomen, and is preceded, as a rule, by a general abdominal soreness. Radiation to the back occasionally occurs, and in one of our patients, distinct pain over the right costovertebral region was observed. Profound shock and collapse, accompanied by a rapid pulse rate with a distinct fall in its volume, ensues, and the patient becomes markedly prostrate. Reyfuss lays stress on the early circulatory collapse, and Deaver says that the contrast of marked collapse and the fairly good pulse, and the presence of cyanosis and dyspnea without any demonstrable cardiac or pulmonary cause, may be said to be typical of acute pancreatitis.

Nausea and *vomiting* are most distressing symptoms, the vomiting usually being of an almost persistent type without relief by medication or gastric lavage. The vomitus is of the bilious variety, and the occurrence of almost constant vomiting should be looked upon as an indication of the possible presence of an inflammatory disease of the pancreas.

The presence of a *swelling* or mass in the epigastrium, though not a constant sign, is frequently encountered. Occasionally, it is located either in the right or left upper abdominal quadrants.

Leukocytosis of from 17,000 to 24,000 is the rule, though in the very acute stages, and before inflammatory signs are fully established, it may be within the normal range.

Muscular rigidity always accompanies this disease in some stage of the development, though *distention*, which in some cases is extreme, may mask this sign. Muscular spasm is most pronounced in the upper quadrants, though the epigastrium is the selective site. As the disease progresses, the rigidity usually extends to the lower quadrants but, unless a general peritonitis exists, the rigidity of the upper quadrants is out of all proportion to that of the lower. In the examination of the case histories, and in our opinion, muscular rigidity is usually very marked, especially after the first thirty-six hours, though, perhaps, it is not as prominent as the intensity of the abdominal pain would suggest.

Abdominal tenderness is constant in some stage of the development of the disease, the usual site of maximum tenderness presenting in the upper quadrants, especially in the epigastrium.

SEVERE.—Where the pancreas is found to be gangrenous, the illness has been of longer duration, though the symptoms are not as stormy as those found in the ultrasevere type.

SUBACUTE.—This grouping embraces those cases which have been of much longer duration, and which rarely present an acute course. The patient is often seen in an intoxicated condition, due often to peritonitis or multiple abscess formation. The presence of an epigastric mass is most often noted in this type. The presence of glycosuria, though an anticipated symptom, due to the relation between the pancreas and the carbohydrate metabolism, is so seldom noted in the

acute cases that its reliability as a diagnostic sign has been overexaggerated. Occasionally sugar in the urine is found, as is also acetone, but it is in the long-standing cases that we are more likely to observe it.

The determination of the blood sugar content should be looked upon as of the greatest importance, and in all cases it should be made. The significance of *hyperglycemia* is of such recent date that a series checked up by this sign has not yet been published, and it is hoped that in the near future such will appear in the literature. Calavazara's experiments show that acute hyperglycemia is an early and characteristic sign of experimental pancreatic necrosis. This hyperglycemia was not accompanied by glycosuria. Reisman emphasizes the importance of this test. No special significance can be attached to age and sex, a fact which is borne out by various authors.

DIFFERENTIAL DIAGNOSIS

Perforation of gastric ulcer or duodenal ulcer	- previous history of pain after food - hemorrhage - vomiting not as constant - rapid collapse not as frequent - muscular rigidity more intense - less and slower distention than in pancreatitis - intensity of pain - circulatory disturbances less pronounced - more of a sudden fall in temperature - more often blood in stool
Cholelithiasis	- usually an interval of pain (Glass, <i>Deutsche Ztschr. f. Chir.</i>, 1923, 177: 123) - if pain is of great severity, patient is restless and rarely shows collapse - signs usually located in upper quadrant
Coronary thrombosis	- often history of previous attacks of angina - usually drop in blood-pressure - signs of slight pericarditis
Intestinal obstruction	- early distention, unless obstruction is high - fecal vomiting - later collapse - constipation - patterns - marked leukocytosis
Mesenteric thrombosis	- may be presence of causal factor - passage of bloody stools - increasing distention with minimal rigidity or without rigidity - physical findings not commensurate with severity of pain and general condition of patient - ineffectual enemata - pain often most severe in back
Gastric crisis	- previous history - repeated vomiting and retching "girdle" pains - negative or slight physical findings - other signs and symptoms of neurosyphilis - Argyll-Robertson pupils - diminished or absent ankle and knee reflexes

- Pneumonia { history of onset
cough
chills
rise of temperature with rapid pulse and respirations
high leukocytosis
chest signs
- Diaphragmatic pleurisy { pain along diaphragmatic attachment
usually cough and increase of pain on inspiration
limitation of respiratory excursion
usually rise of temperature
may hear friction rub
- Perforative appendicitis with genreal peritonitis { sudden rupture of periappendical abscess into general peritoneal cavity may simulate pancreatitis
history of previous attacks and of present illness important
location of greatest pain prior to rupture usually in lower quadrant
rigidity and tenderness remain most marked over appendical region
often tenderness upon rectal examination
- Twisted ovarian cyst { this can usually be differentiated by careful abdominal and pelvic examination
- Extra-uterine pregnancy { initial pains frequent in epigastrium, or about umbilicus
uterine bleeding following onset or before
uterine palpation suggestive of pregnancy
doughy feel in culdesac, with tenderness or mass to side of uterus
leukocytosis, often pronounced
feeling of faintness at onset
menstrual history
- Visceral perforations { intestinal perforations following injury, or in the course of typhoid fever, tuberculosis, dysentery and various types of obstructions
previous history most important
rigidity of abdomen usually widespread and intense
rising pulse rate, with falling temperature, at onset
later, increased temperature and signs of general peritonitis
- Urinary bladder perforations { dependent upon injury, including instrumentation, malignancy and various causes of urinary obstruction or bladder inefficiency, which might cause overdistention
history of difficulty in urination, dribbling, hematuria
signs and symptoms usually confined to pelvic region or lower abdomen
extravasation of urine into abdominal wall, perineum, external genitalia
catheterization with instillation of measured amount of sterile solution
- Gall-bladder perforations { occur as a complication of acute gangrenous cholecystitis, empyema of gall-bladder, hydrops of gall-bladder
similar attacks, suggestive of gall-bladder or gall-stone disease
perhaps slight jaundice, or previous jaundice
indigestion
pain and physical signs usually greatest in gall-bladder region

Acute gastritis	{	ingestion of irritating substance (food, beverage or chemical)
		repeated vomiting
		often diarrhea
		distention without rigidity
		relieved by lavage, antidotes or strict diet
Irritating poisons	{	history of cases
		severe subjective signs with little or no distention or rigidity
		diarrhea
		laboratory examinations

CONCLUSIONS.—1. That the most common age is between thirty and fifty years, although the condition has been found in the young child and in the aged. (From statistics.)

2. That sex plays an unimportant part.

3. That in the vast majority of cases a previous history covering a period of from a few weeks to years of “chronic indigestion” or “gall-bladder” attacks with acute exacerbations, has been present.

4. That the disease, especially in the first thirty-six hours, is practically always of very acute onset, exhibiting subjective and constitutional signs so severe as to be out of all proportion to the physical signs found upon examination. As the lesion progresses, physical signs may overbalance the subjective symptoms.

5. That epigastric and upper abdominal quadrant pain, of an almost constant type, is the most severe of any of the diseases caused by an intraperitoneal lesion and is usually not relieved by morphin.

6. That the temperature is usually normal, or subnormal with moderate or rapid rise in the pulse rate, often accompanied by dyspnea and a subcyanotic condition of the skin.

7. That vomiting is found very early in the disease, is persistent and almost constant, and is usually not relieved by lavage or medication.

8. That glycosuria is a most inconstant and rare occurrence but when found is of extreme diagnostic importance.

9. That the presence of hyperglycemia is of great significance and should be investigated in all cases of suspected pancreatitis.

Abscess.—Abscess of the pancreas is not a very uncommon condition, and occurs most often following the acute infectious diseases and the inflammatory processes of the pancreas. The cases of acute pancreatitis that recover from this lesion often present abscess as a sequela. Recognition of this disease may be made in most cases by the history; the presence of a more or less tender, globular mass appearing in the epigastrium; *vomiting of a rather persistent nature*; and rise of temperature with a marked increase in white blood-cells. Muscular rigidity in the epigastrium is practically always present. Pain is of a continuous nature and is not relieved by position or posture. It should be remembered, however, that pain may be of a very negligible nature. Glycosuria, and an increase in the blood sugar index, may be present. One should not be misled by the absence of fluctuation.

Chronic Pancreatitis.—This lesion is so seldom associated with the signs and symptoms especially referable to a disease of the pancreas that a definite diagnosis is seldom made, with accuracy, during life. The etiologic factors entering into the disease are usually, however, of such a special nature that they must be considered

Disease	Age	Pain (Type and Radiation)	Temperature	Abdominal Rigidity	Abdominal Tenderness
Acute gastro-enteritis (very severe type)	Any ; commonly noted in infants and children.	Sharp, colicky and intermittent, extending over all of the abdominal quadrants and with no definite localization.	Usually sharp rise.	General without predilection for any particular quadrant or point.	Usually soreness over entire abdomen, seldom severe.
Acute pancreatitis	Usually after 40.	Extremely sharp and continuous, though it may be paroxysmal. Epigastrium, extending over abdominal quadrants, then diffuse and finally becoming most marked over epigastrium and upper right and left quadrants.	Rise, subnormal, then rise.	Over entire abdomen, most pronounced over epigastrium and upper quadrants.	Always present over epigastrium and upper quadrants, less severe over lower quadrants.
Coronary thrombosis	Usually after 45.	Severe and sudden, lasting from a few minutes to a few hours, most especially marked in epigastrium, and usually becoming somewhat diffuse and radiating to left upper quadrant, occasionally to left arm.	None or slight.	Diffuse, but usually marked over epigastrium and upper quadrants.	Usually marked over epigastrium and upper abdominal quadrants.
Ectopic pregnancy	Child-bearing period.	1. Acute, diffuse with no localization. 2. Dull, intermittent in pelvic region. 3. Dull and intermittent in pelvic region followed by very sharp and sudden pain which quickly becomes diffuse and localizes.	Sudden drop, gradual rise.	Diffuse and most marked over pelvic region (with rupture), right or left lower quadrant without rupture.	Diffuse but most marked over pelvic region (with rupture) usually fairly marked over left and right lower quadrants (without rupture).
Intestinal obstruction (especially of small intestine or complicated with perforation of same)	Any age.	Diffuse, severe and colicky. The most intense pain is usually present over site of coil or coils involved.	Subnormal then gradual rise.	Diffuse boardlike rigidity most pronounced over site of perforation or obstruction.	Diffuse and most marked over site of lesion.

Abdominal Mass	Blood	Stools	Urine	Special Data
None.	Usually hyperleukocytosis.	Diarrhea. Usually blood in stools.	Usually indicanuria. Often signs of a chronic nephritis. B. coli commonly found.	Nausea, vomiting, vertigo and headache are often present. There may be a history of dietary indiscretion, recent "debauch" or acute infectious disease. Abdominal distention may or may not be present. Often reacts quickly and favorably to catharsis. Jaundice occasionally present.
Markedly tender, immobile and indefinite mass in epigastrium verging toward upper quadrants.	Usually hyperleukocytosis. At times, hyperglycemia.	Often fatty and of light color.	May be dextrose and bile.	Nausea, repeated vomiting and distention are practically always present, in fact all the signs of peritonitis are observed. May be accompanied by slight or extensive jaundice. Most frequently found in men. History of alcoholism, and previous attacks of indigestion are not uncommon.
Usually negative. There may be found an enlarged liver and gall-bladder giving evidence of a mass.	Negative. Wassermann reaction may be present.	Negative.	Often signs of a chronic nephritis.	A pericardial friction rub is commonly found while the heart sounds usually are regular but distant. Low blood-pressure. Fever is found present and the previous history of frequent attacks of chronic indigestion, including repeated attacks of pain in epigastrium, are not uncommon. Nausea, vomiting, distention may or may not be present.
Usually mass felt in pelvis, either retro-uterine or in right or left lower quadrants.	Hyperleukocytosis, if large amount of blood in abdomen. Signs of secondary anemia.	Negative.	Usually negative.	Very often found in women with a more or less protracted period of sterility. Occasional signs of pregnancy. Uterine bleeding commonly found. Abderhalden reaction. Nausea, vomiting and distention.
May often be felt over site of lesion, especially if constriction due to tumor. Intestinal patterns usually present.	Negative unless peritonitis develops.	If obstruction is high up, may be diarrhea for several hours. Often absence of stools. May or may not contain blood.	Negative in early stages. Later, signs of severe acute nephritis.	Possible history of previous operation or frequent attacks of severe obstipation. Often the history of passing of small or large amounts of blood. Usually dark. Nausea, vomiting, at times of fecal type, and distention. In a large number of cases visible peristalsis noted.

Disease	Age	Pain (Type and Radiation)	Temperature	Abdominal Rigidity	Abdominal Tenderness
Mesenteric tear.	Any age.	Diffuse, constant or intermittent. May become localized over site of rupture, following a generalized diffuse pain over the entire abdomen.	Subnormal with gradual rise.	Moderate degree of diffuse rigidity unless complicated with intestinal involvement, when it may become most pronounced. Degree of rigidity is increased over site of rupture.	May be only soreness over entire abdomen, perhaps increased over site of tear: tenderness may be pronounced.
Perforation of abscess into free peritoneal cavity	Any age.	Diffuse, sharp and constant. Most intense over site of perforation.	Septic type.	Diffused board-like rigidity most pronounced over site of perforation.	Diffuse, but most marked over site of perforation.
Perforation of gall-bladder	Usually after 40.	Tearing, continuous and diffuse, most intense over right upper quadrant and right flank.	Subnormal then fairly rapid rise.	Diffuse boardlike rigidity most pronounced over site of perforation.	Diffuse but most pronounced over right upper quadrant, epigastrium and right flank.
Perforation of intestine	Any age, if traumatic. If from tumor after 40.	Tearing, continuous and diffuse until atony ensues. Most acute over site of perforation.	Subnormal then gradual rise.	Diffuse and most marked over site of perforation.	Diffuse but most marked over site of perforation.
Perforation of stomach or duodenum	Usually 20-45.	At first diffuse, tearing and continuous, most intense over right upper quadrant and epigastrium. Piercing pain directly through into back, is not uncommon. Often initial stabbing pain in epigastrium.	Sudden drop then gradual rise.	Diffuse boardlike rigidity most pronounced over site of perforation.	Diffuse but most marked over right upper quadrant and epigastrium.
Peritonitis, acute fulminating (varied etiology)	Any age. Pneumococci type, infants and children.	Type varies and may be of all varieties. Diffuse without special localization, though at times more pronounced over site of the cause.	Rapid rise.	Marked and diffused over entire abdomen, with an increase of intensity over site of etiologic factor.	Marked and diffused over entire abdomen with an increase of intensity over site of etiologic factor.

DIFFUSE ABDOMINAL PAIN WITH SHOCK (Continued)

Abdominal Mass	Blood	Stools	Urine	Special Data
Usually neg- ative.	Signs of sec- ondary anemia.	Negative.	Usually neg- ative.	Practically always follows an injury.
Usually mass over site of abscess.	Usually hyper- leukocytosis.	Usually neg- ative. If ab- scess involves intestine, may have tarry or bright red blood.	If abscess in- volves blad- der, red blood and pus cells.	A preëxisting abscess may have been noted. All signs of a rapidly progressing peritoni- tis become evident.
Usually a per- pendicular fairly oval mass in right upper quad- rant, related to liver dul- ness.	Usually hyper- leukocytosis.	Usually no change. Dim- inution in bile content may be present.	May or may not contain bile.	Often history of previous indi- gestion, of gall-bladder and so-called "bilious attacks." Occasionally follows an acute infectious disease. Chills are not uncommon. Jaundice may rapidly develop.
None.	Leukocytosis which may be- come marked.	Usually tarry, microscopic blood always present.	Negative, ear- ly stages, later on signs of fairly acute nephritis.	Usually follow injury, ty- phoid fever, malignancy or strangulation of the intestine though occasionally it is a complication of a tuberculous enteritis.
If perigastric abscess is present usu- ally a mass; otherwise none felt.	At first slight or no rise in leu- kocyte count, as peritonitis ensues, there is usually a moderate leu- kocytosis.	Often tarry. Microscopic blood always present.	Negative.	Especially common in anemic women, cooks and cobblers. Usually history of previous indigestion. See chart "Hema- temesis." Duodenal ulcer of- ten in the plethoric male.
None.	Fairly high or very marked increase in the leuko- cytes.	Negative.	Usually neg- ative at first, fol- lowed by signs of an acute neph- ritis.	If possible, determine, clini- cally, source.

seriously, when known to exist. The disease is often secondary to changes in the intestine, bile passages and liver, and to any obstruction to the outflow of the pancreatic glandular secretions. Syphilis, alcohol, arteriosclerosis and tuberculosis are, at times, associated with the lesion. In the present state of our knowledge the most probable causes are an ascending infection from the duodenum or gall-bladder, pancreatic and biliary calculi, and new growths compressing or invading the pancreas. The disease generally occurs between the ages of forty to sixty; its onset is often so slow and insidious that the mild digestive disturbances which the patient may experience are looked upon for the time being as inconsequential; indeed, the primary symptoms are usually those of the primary cause, rather than any emanating from the pancreas itself. Added to variable gastric disturbances, a dull, more or less constant pain in the epigastrium with a progressive jaundice, accompanied by loss of weight and weakness, suggests a pancreatic lesion of this type. The stools may be fatty and, occasionally, sugar appears in the urine, and in many cases there is a definite increase in the blood sugar index. The Cammidge reaction in the urine may or may not be present, though its absence means nothing when making a diagnosis. Hypertrophy of the liver with intense pigmentation of the skin may be present, though its absence is not a determining factor. Usually the jaundice, though progressive, is of less intensity than in pancreatic carcinoma; the frequent attacks of fever are more marked than in carcinoma. In carcinoma the gall-bladder is considerably enlarged, as opposed to this condition. An enlarged pancreas may be felt in both diseases, especially in those patients with a general enteroptosis.

Calculi

Pancreatic calculi are most commonly found in men between the ages of thirty and forty. The condition is fairly rare and is difficult of diagnosis, though radiograms are of considerable aid. As a rule, the diagnosis is not made clinically. The pain encountered in this condition resembles in all respects that of gall-stone colic though, perhaps, of less intensity. Vomiting and prostration may follow an erosion of the pancreas with an accompanying pancreatitis, followed by high rise of temperature with chills. Jaundice may or may not be present. Sugar in the urine and an increase in the blood sugar index are rare. In very rare instances, pancreatic calculi have been found in the stools. The stools may be fatty.

Granulomata

Tuberculosis.—Tuberculosis of the pancreas is of very rare occurrence, and only appears as a lesion, secondary to tuberculosis elsewhere in the body. Pain in the epigastrium, and perhaps a palpable tumor of the pancreatic region may, in the presence of other known foci of tuberculosis, suggest this lesion.

Syphilis.—Syphilis of the pancreas may be congenital or acquired. A clinical diagnosis cannot be made.

Cysts

Pancreatic cysts may occasionally follow abdominal injury, although the history of trauma may be entirely absent. They are generally distinguished by their more

or less spherical outline, with smooth surface, situated in the midline of the abdomen, between the ensiform cartilage and the umbilicus, or slightly to the left of that location. The mass may be so tense as to give no sense of fluctuation on palpation, or it may be fluctuant. The contour of the abdomen, if the cyst is of sufficient size, shows a definite bulging in the epigastrium. Unless the cyst involves only the tail, and this is very unusual, the mass is immobile; and, often, when in juxtaposition with the aorta, transmits *a pulsation which entirely disappears if the knee-chest position is assumed*. Pain may be an important factor and often occurs in paroxysms. On the other hand, there may be an entire absence of this symptom. Pressure upon the bile-ducts may, in rare instances, cause a progressive jaundice. The mass is painless on pressure. Inflation of the stomach may aid in the mapping out of the cyst, the stomach lying above the cyst. The mass may be located either above or below the transverse colon.

Tumors

Benign.—Cystic adenomata and lymphadenomata of the pancreas have been occasionally described, but their rarity is so pronounced that they should be considered as possibilities, and no more. The diagnosis, clinically, is an impossibility; the only excuse for even mentioning them being that they, at times, grow to sufficient size to be felt, or to cause pressure symptoms upon the ducts or adjacent organs.

Malignant.—*Sarcoma.*—Sarcoma of the pancreas is of extreme rarity, and clinically it corresponds in all respects to carcinoma. Theoretically, it is supposed to occur at an earlier age than carcinoma, and to grow perhaps more rapidly; the impossibility of making a clinical diagnosis of this condition prevents any great stress being placed upon its existence. Secondary involvement is not so uncommon.

Carcinoma.—Carcinoma of the pancreas is by far the most frequent of the new growths of the pancreas. It usually occurs after the age of forty, and is especially likely to arise in the males; females, however, are not immune. The signs and symptoms entirely depend upon its location, extent of encroachment on other organs, and its size. The head of the pancreas is more often involved than is the tail or body, and hence the train of symptoms form, under ordinary conditions, a definite symptom-complex which, to the average physician, is almost pathognomonic of the disease.

The earliest symptoms are a sense of discomfort and uneasiness in the epigastrium, irrespective of the taking of food; of a gradual distaste for food; in the earliest stages especially, abhorrence for meats, a mild grade of nausea and, occasionally, vomiting; in this stage, the movements may be perfectly normal, without obstipation or diarrhea, and of normal color. As the disease progresses, a slight yellowish discoloration of the skin occurs, which soon becomes more marked and progressive, eventually leading to a dark, dirty yellow, which so increases that, at times, it becomes almost black. The stools correspondingly become pale and then pasty, with no remittance in the change of color once they have assumed the pasty aspect. Rapid loss of weight ensues, resulting in emaciation. Nausea and vomiting become more frequent, the vomiting often assuming the more or less persistent type. The gall-bladder and liver enlarge, and intense prostration ensues. The pain may or may not become intense, depending upon the encroachment upon the nerve

Tumors	{	benign	{ adenoma angioma fibroma lipoma myxoma endothelioma
		malignant	{ carcinoma sarcoma (lymphosarcoma, round cell)

The spleen is a large lymphoid structure lying in the upper left hypochondrium. Normally it measures about 3 by 5 inches. It lies beneath the ninth, tenth and eleventh ribs extending from a point $1\frac{1}{2}$ inches to the left of the midspinal line posteriorly, nearly to the midaxillary line laterally. The long axis runs downward and upward parallel with the ribs. It is in relation with the kidney posteriorly, above with the diaphragm and below with the stomach, colon and intestines. The splenic area may be marked out by drawing on the back two horizontal lines from the spinous processes of the ninth dorsal and first lumbar vertebræ. These are joined by a vertical line $1\frac{1}{2}$ inches to the left of the spinous process, and another corresponding to the left midaxillary line; within this space normally lies the spleen.

The examination of the spleen should begin with *inspection*. This is of no value unless the organ is greatly enlarged. It may then be seen as a protruding mass extending from the left hypochondriac region downward and across the abdomen even as far as or beyond the umbilicus. This mass moves with respiration.

Palpation of the spleen should be carried out when the patient is in a recumbent position. One hand should lie flat upon the abdomen so that the finger tips can exert pressure upward beneath the left costal margin. If the spleen is enlarged, it may be felt without difficulty. Palpation may be aided by reinforcing pressure from the back with the other hand. It is sometimes of value to have the patient draw several deep breaths which will reveal the sharp edge of the spleen slipping under the ends of the fingers.

Percussion of the spleen may be carried out, the patient either sitting, standing or lying partially on the right side. The left arm should be placed over the head. Percussion should be made downward toward the splenic area and upward, to outline this region. Several conditions interfere with proper valuation of splenic dullness such as left pleural effusions, enlarged kidney, consolidation of the left lower lung, subdiaphragmatic abscess and fecal masses in the colon.

Auscultation of the spleen is very rarely of value. A friction sound may be heard if there is inflammation about the spleen.

Injuries

Contusion and Rupture.—See “Injury of Spleen” under section on “Abdominal Injury.”

Inflammatory Conditions

Acute suppurative splenitis is a rare condition, but when occurring it presents in two forms. The first, following one of the acute infectious diseases, and as a sequel to a preëxisting acute splenitis; the other, due to multiple infected emboli.

In the first form, the spleen becomes degenerated to such an extent that there may occur a softening of the entire organ, with one large abscess sac. In the second form, the picture is one of multiple minute abscesses. The clinical picture of both types is the same, namely, enlargement and tenderness of the spleen, temperature with usually the presence of chills, leukocytosis and signs of toxemia. At times it is possible to aspirate the pus. The history of a preëxisting disease is often helpful in arriving at a diagnosis.

Abscess.—Solitary abscesses of the spleen are not of rare occurrence and usually appear as metastatic abscesses from some focus elsewhere in the body. As a primary lesion, it may be caused by injury or by an infected hematoma, or may be due to direct inflammatory extension. A number of cases present without any known etiology. It should be borne in mind that the most frequent sources are preëxisting pyemia, typhoid fever, appendical or liver abscess and any one of the acute infectious diseases.

As a rule, the obscurity of symptoms in the beginning and even late in the disease, is worthy of mention. Irregular and severe chills accompanied by a high rise in temperature, generally of the septic type, are as a rule the earliest manifestations of the disease. This irregular rise in temperature, with a gradual loss of weight and strength, together with a mild digestive disturbance, may continue for a period of days and even weeks before attention is diverted toward the splenic region; the cause of splenic region attention being perhaps brought about by mild or severe pain over that region, or in the lower left thorax. Pain is not, however, of much significance, and may be due to other causes such as a pleurisy, or a kidney or splenic infarct. The position of the abscess may, at times, hasten the diagnosis, since the lower splenic pole, if affected, may give rise to early splenic tenderness on palpation and pressure, and may occasion a definite abdominal mass. If there is an involvement of the upper pole, the signs and symptoms may all point to a subdiaphragmatic abscess or pleurisy, especially with effusion. As in a subdiaphragmatic abscess, the diaphragm may be pushed up and diaphragmatic movements absent, as seen by the fluoroscope. Pool and Stillman mention the possibility of there being slight edema of the lower intercostal spaces. The white blood-count is, as a rule, very high, the leukocytosis reaching thirty-five thousand or more. Aspiration of the suspected area will, of course, materially aid in the diagnosis, especially if pus is obtained, together with splenic detritus. Occasionally, the whole process will first exhibit itself by a sharp pain in the left upper quadrant, as so well evidenced in a case of A. W. Elting's which the writer had the opportunity of seeing. There are cases which apparently give but few of the above signs and symptoms, and which undoubtedly are not diagnosed clinically. One's diagnostic skill is severely tested in this type of case.

Pearce and Krumbhaar, in discussing the etiology, say: "Because of the greater frequency of malaria, dysentery and typhoid fever in tropical countries, and of the peculiar susceptibility of the spleen to these infections, abscess of the spleen is of greater incidence in the warm and tropical climates than in the temperate zone."

Acute Perisplenitis.—This is usually caused by an inflammatory process from within the spleen, or from an extension from a neighboring organ. Its chief clinical manifestation is pain, which at times is the first symptom directing one's attention to the spleen or adjacent viscus.

DIFFERENTIAL DIAGNOSIS OF CONDITIONS CAUSING ACUTE PAIN IN THE LEFT UPPER ABDOMINAL QUADRANT

Coronary thrombosis } Acute pancreatitis }	See Differential Chart, "Differential Diagnosis of Conditions Causing Acute Diffuse Abdominal Pain with Shock," pages 694-697.
Acute enterocolitis } Intestinal obstruction } Acute pyelitis }	See Differential Chart, "Differential Diagnosis of Conditions Causing Acute Pain in Right Lower Abdominal Quadrant," pages 648-651.
Gastric ulcer } Gastric tumors }	See Differential Chart, "Differential Diagnosis of Conditions Causing Hematemesis," pages 624-629.
Herpes zoster } Intercostal neuralgia } Pleurisy } Pneumonia } Renal calculus } Torsion of kidney } Subphrenic abscess }	See Differential Chart, "Differential Diagnosis of Conditions Causing Acute Pain in Right Upper Abdominal Quadrant," facing page 720.
Acute dilatation of stomach.	Occurs most especially in the young adult, though no age is exempt. Severe epigastric pain, often radiating to left upper quadrant, is usually present. Muscular rigidity and tenderness may or may not be present. There is marked abdominal distention and the borders of stomach may be seen far beyond their normal limitations. Epigastric bulging, pronounced. Nausea and vomiting and often prostration are noted. The vomitus is usually copious and contains little or no HCl. Persistent vomiting, noteworthy. Urine scanty.
Acute splenitis	Occurs at any age. Dull ache in left upper quadrant which often radiates to epigastrium and left lower quadrant. Muscular rigidity may be slight or marked in left upper quadrant. Tenderness and enlargement of the spleen are present. High fever with chills, usual. Leukocytosis. Signs of toxemia usually present. History of one of the acute infectious diseases, common. Splenic abscess may follow with an aggravation of the above symptoms and signs.
Splenic infarct	Usually is recognized by sudden and sharp pain in the upper left quadrant, occurring in the course of one of the acute infectious diseases or in one with a heart lesion. The spleen becomes enlarged and tender and the signs of an acute splenitis ensue.
Rupture of spleen	See section on "Abdominal Injury."

Aneurysm

Aneurysm of the Splenic Artery.—Pool and Stillman have so completely reviewed this condition in their recent work that the text on this subject has been more or less taken directly from their book. "The etiology . . . is obscure. Compression or kinking of the vessel as the result of displacement of the spleen, especially of an enlarged spleen, may be suspected as acting as a contributory factor. The cause of the changes in the vessel wall is usually left doubtful in the available reports. It is possible for a false aneurysm to develop in the presence of a defect of the splenic vessels resulting from wounds. The factors which apparently exert an influence in the development of aneurysm here, as in others, are traumatism, arteriosclerosis and infection."

From Pool's résumé of the subject, it is apparent that the condition is of extreme rarity; that, in the majority of the cases heretofore reported, the onset is slow and insidious and that the presenting symptom years afterward may be abdominal pain referred to the "left side." The spleen usually becomes somewhat enlarged and may present pulsation, bruit or thrill. "The symptoms of aneurysm are far from distinct and it is not surprising that the diagnosis has rarely, if ever, been rendered before operation."

Thrombosis and Embolism

Thrombosis of the splenic vessels is a rare occurrence. It is associated with mesenteric and portal thromboses, with acute pancreatitis and, exceptionally, with typhoid fever. It is characterized by splenic enlargement, sometimes with attendant pressure symptoms, and by epigastric or left upper quadrant pain. The symptoms are not distinctive and, being masked by associated conditions, are not of diagnostic significance.

Embolism of the spleen occurs in septicemic infections, but develops more particularly from endocardial and aortic sources. Having recognized these underlying conditions, the development of splenic infarction may be inferred from sudden sharp pain in the splenic region, often with temperature rise. This may be more evident upon inspiration. Infarction usually being multiple, a tender enlargement of the spleen frequently ensues. Most emboli are infective and abscesses develop. The softening and hemorrhage following infarction constitute conditions favorable to the development of cysts of the spleen.

Granulomata

Granulomata of the spleen, including actinomycosis, glanders, syphilis, tuberculosis, and leprosy, represent secondary involvement and should not be considered from the surgical standpoint, other than that the forming of a diagnosis may bear some light on the ultimate prognosis of the case.

Malarial Spleen

The malarial spleen has been at times treated surgically, but removal in these instances has met with so little relief that at the present time this condition is not considered surgically. A large, smooth and definitely notched spleen, insensitive or slightly sensitive on pressure, in a patient who has or is suffering with malaria, makes up the clinical picture.

Rachitic Spleen

The rachitic spleen is one of the signs of a well-advanced stage of rickets. It is regular, smooth and non-sensitive. Enlargement may be pronounced. It should not be considered surgically. See "Von Jaksch's Anemia."

Wandering Spleen

The wandering spleen, often called dislocated, or ectopic spleen, is especially encountered in those who have had a preëxisting splenomegaly due to one cause

or another. As a rule, it is found in those who have naturally weakened abdominal muscles, with a general visceroptosis. It may, on the other hand, occur in the perfectly normal individual. According to Pearce, Krumbhaar and Frazier (*The Spleen and Anemia*, J. B. Lippincott Co., Philadelphia, 1918, p. 341), "In most instances the causes of wandering spleen are acquired, although in exceptional instances, congenital elongation of the mesentery may permit of a wide excursion." The symptoms of this condition vary in their intensity, depending for the most part on whether a sudden rotation of the spleen with a twisting of its pedicle occurs. In such instances a most acute abdomen will present, with its accompanying signs and symptoms. Sudden and very diffuse abdominal pain, most pronounced over the left upper quadrant, diffuse abdominal rigidity, tenderness, distention and a fairly hard, regular, tumor mass, detected in any part of the abdomen, especially in the left abdomen, may present. Gangrene of the spleen with a concomitant peritonitis, occasionally follows. Without pedicle twisting, the signs and symptoms are a dragging sensation and abdominal discomfort, with a palpable mass in one or another of the abdominal quadrants (especially in the left upper and lower), and aid in the forming of a diagnosis, especially if pressure symptoms upon other viscera show themselves. At times the diagnosis cannot be made.

Splenomegaly as Associated with Blood, Bone-Marrow and Liver Conditions

Banti's disease is essentially a condition of adult life in which there is a splenic enlargement with a subsequent atrophic cirrhosis of the liver. Its etiology is unknown, despite the advancement of numerous theories as to its causation. In many instances the disease so closely resembles Laennec's cirrhosis that many observers will not differentiate the two, and believe that one is part of the other. In a differentiation, if this is possible, Moynihan (*The Spleen and Some of Its Diseases*, W. B. Saunders Co., Philadelphia, 1921, p. 85), states as follows: "If the ordinary clinical course is followed, there is no doubt that in Banti's disease the splenic enlargement precedes the affection of the liver, whereas in Laennec's cirrhosis, the liver is first attacked; though in some cases the splenic enlargement may be so considerable as to distract attention from the less obvious change in the liver." Osler's conception of splenic anemia so closely resembles Banti's disease that it is difficult to consider one without the other. In our conception of Banti's disease, we presuppose that at some stage of the disease there is a true atrophic cirrhosis of the liver. Osler's description of splenic anemia includes the remark, ". . . and in many cases a terminal stage with cirrhosis of the liver and jaundice" (*Am. J. M. Sc.*, 1900, 119:54). It leaves a doubt in our mind whether the two should be classified and discussed together. Krumbhaar, in a very thorough review of the subject, goes so far as to say: "The term 'splenic anemia' is now known, however, to include several distinct types and its use should be restricted if not, indeed, discarded entirely." (Krumbhaar, *The Spleen and Anemia*, J. B. Lippincott Co., Philadelphia, 1918, p. 242.)

Splenic Anemia.—From the clinical viewpoint, splenic anemia includes the same signs and symptoms as does Banti's disease, with the exception that at some stage of the disease an atrophic liver is always found; in splenic anemia, though usually found in its terminal stages, it is not constant.

The so-called Banti's syndrome comprises three stages: (1) Gradual signs of a secondary anemia with increasing loss of appetite and strength, of vague or fairly marked gastro-enteric disturbances, and varying degrees of abdominal discomfort, usually most pronounced over the epigastrium and left upper abdominal quadrant. Mucous membrane bleeding, or even severe hematemesis, may suggest gastric or duodenal ulcer or carcinoma. This stage may extend over a period of years, during which time the spleen slowly becomes enlarged and is notoriously smooth, hard and regular, with a clean-cut definition on palpation of the splenic notch. The urine at this period shows an increase of urobilin; there is nothing characteristic about the blood, though a decrease in the number of white blood-cells is usually present. (2) During this period which, as a rule, lasts only over the course of a few months, the abdominal discomfort becomes worse, the enteric symptoms more severe, the frequency and severity of hemorrhage more marked and the liver shows slight enlargement. Signs of an acute nephritis with an increase in urobilin ensue, and loss of strength is pronounced. (3) The last stage of the disease is indicated by an atrophied liver with its accompanying signs and symptoms of an atrophic cirrhosis of the liver. Ascites is present, occasionally slight jaundice, marked emaciation and anemia. The spleen becomes progressively larger, and after months or perhaps a few years, hemorrhage or an intercurrent disease closes the chapter.

Chauffard-Minkowski's disease is a condition in which an hemolytic jaundice is present, together with splenic enlargement. It may be of the *congenital* or *familial* type. In both forms the symptoms are essentially the same: in the former, the jaundice appears soon after birth, while in the latter, pigmentation usually presents in childhood, or perhaps in early adult life. The tendency for it to occur in many members of one family and in succeeding generations is noteworthy. Jaundice with no bile in the urine and with normal stools, splenic enlargement, anemia and a diminished resistance of the red blood-cells to hypotonic salt solution form part of the symptom-complex. Chronicity is the rule, and even though the jaundice may be pronounced, the patient rarely shows signs of an acute illness and may live to an old age, jaundiced to the last—dying, as it were, from either old age or an intercurrent disease.

Hayem-Widal's disease is the acquired form of hemolytic jaundice. The symptoms are, as a rule, much more severe than those of the congenital form, developing suddenly, especially in the young adult or adult woman, and often progressing rapidly to a marked anemia, a pronounced jaundice, intermittent attacks of diffuse abdominal pain, at times most marked in the splenic area, acute exacerbations of fever and with acute swelling of the spleen and splenic tenderness. A very acute anemia may present and urobilin is found in the urine. The presence of cholelithiasis is frequent in this type.

Gaucher's disease is a splenomegaly of childhood, usually occurring, according to Mandelbaum and Brill, before the thirteenth year (*J. Exper. M.*, 1912, p. 697); (*Am. J. Med. Sc.*, 1913, 146:863). The distinguishing features are as follows: The appearance of a very marked splenomegaly in childhood; the frequent occurrence in the same family of a similar disturbance; the chronicity of its course over a period of years, without signs or symptoms other than that of an enlarged spleen; the very marked tendency for the lesion to appear in girls; the sudden appearance, after the lapse of some years, of a pronounced anemia; tendency

toward hemorrhage (mucous membrane and subcuticular); the progressive splenic enlargement; the chlorotic type of anemia; the decrease in the white-cell count; the gradual enlargement of the liver—"a uniform discoloration of the skin of the face, neck and hands and a wedge-shaped thickening of the conjunctiva on either side of the cornea" (as quoted by Moynihan, *The Spleen*, W. B. Saunders Co., Philadelphia, 1921, p. 102). The urine contains urobilin with no bile. An important characteristic is that, though the liver enlarges, the general health is not impaired. Ascites is not present. The patient generally dies from an intercurrent disease, years after the appearance of the splenic enlargement.

Von Jaksch's Anemia (*Anemia Pseudoleukemia Infantum*).—This may be considered as a disease of infancy, exhibiting itself by a train of symptoms pathognomonic of the condition. The important features are a strikingly large spleen; marked anemia with its accompanying signs, such as bleeding from the mucous membrane; heart murmurs (hemic); a somewhat enlarged liver; and possibly enlarged lymph glands. The blood-picture, in combination with the finding of an enlarged spleen, and in an infant, should confirm the diagnosis. In this disease there is a marked diminution in the red blood-cell count, with a very pronounced increase in the white cells, the lymphocytes predominating. Myelocytes and nucleated red cells are constantly found. Rickets and tuberculosis are supposed to be predisposing causes. These cases generally recover following appropriate treatment.

The **leukemic spleen** is usually mentioned as a surgical possibility. Splenomegaly with the typical blood-picture of a myelogenous leukemia confirms the diagnosis.

Cysts

Cysts of the spleen may be parasitic or non-parasitic. Echinococcus disease of the spleen is rare, but it is the most common form of cyst in this organ, occurring in about 3 per cent of cases of the disease. The way in which the infection reaches the spleen is unknown; it is thought that the embryos enter the portal system, are carried to the liver and reach the spleen by venous channels. The organ enlarges, becomes elongated, and early forms adhesions to the diaphragm, stomach, intestines, omentum and other structures. Most of the cases are seen in adult life, between twenty and fifty, and sexes are equally divided. Symptoms depend on mechanical disturbances, size, adhesions and rate of growth. In rare cases the cyst ruptures into the intestinal tract or peritoneal cavity. Occasionally pyogenic infection occurs, which gives symptoms and signs of an acute suppurative splenitis. The content of the cyst is a thin, pale fluid containing the characteristic hooklets and scolices of the echinococcus.

Non-parasitic cysts of the spleen are dermoid, serous, blood or lymph, in origin. All of these are extremely rare, especially the dermoid, of which Keen could find only one case. The blood-cysts are more common, their contents depending on age, at first being pure blood, later changing to chocolate color and then to yellow serum with shreds of fibrin, cholesterin and deposits of blood-pigment. A mild perisplenitis with slight adhesions follows. Most of the serous cysts are originally hemorrhagic in origin. Lymph cysts, due to an ectasis of the lymphatics, contain a fluid which tends to coagulate spontaneously and has a higher specific gravity than the contents of a serous cyst. All of these cysts may give rise to no symptoms and

DIFFERENTIAL DIAGNOSIS OF CONDITIONS CAUSING

Symptom	Aneurysm (Splenic and Renal Arteries; Thoracic Aorta)	Chronic Colitis	Banti's Disease	Chronic, Passive Congestion (Splenic)	Chronic Splenitis and Perisplenitis
Age	Middle and advanced age.	Adults.	Young adults. Especially males.	Any, especially children and middle or advanced age.	Any.
Pain (type and radiation)	Dull, dragging; sense of weight or fullness; or neuritic type with radiation into lower abdomen, back and lower extremities. Sometimes deep-seated, boring or severe type.	Cramplike, colicky, along course of colon. Rectal tenesmus.	Absent, or slight in left upper quadrant. Increased in late stages.	Usually moderate in left hypochondrium.	Pain more evident in perisplenitis. Dragging type; or sharp, aggravated by deep breathing, and straining.
Temperature	Normal.	Normal or occasional elevation.	Normal.	Not significant.	Normal, or intermittent.
Abdominal rigidity	Present or absent. Extent and site varies with vessel affected.	Slight or absent. Increased at times.	Usually absent.	Slight, if present.	Absent or slight. More marked in perisplenitis.
Abdominal tenderness	Present or absent.	Along course of colon.	Moderate tenderness over spleen.	Tenderness over spleen.	Usually, tender to some degree.
Mass	Tense, cylindrical or rounded; deep-seated. Expansile pulsation. Mass is fixed.	None, unless impacted colon or gas in gut.	In splenic region; usually fairly large, normal or somewhat increased consistency. Smooth, regular.	Splenic enlargement, firm, smooth. Enlarged liver.	Moderately enlarged spleen; normal or increased consistency; smooth.
Stools	Negative.	Blood, excessive mucus, greenish stools, sometimes pus. Chronic diarrhea. Sometimes parasites and ova.	Negative or melena.	Negative.	Negative.
Blood	Negative.	Negative or secondary anemia.	Severe, progressive secondary anemia.	Negative.	Negative or secondary anemia.

CHRONIC PAIN IN LEFT UPPER ABDOMINAL QUADRANT

Cysts and Parasitic Disease (Splenic)	Gaucher's Disease	Leukemia	Splenic Tumors	Symptom
Any. Mostly adults.	Infancy and early childhood.	Adult and middle age.	Children. Adults.	 Age
Absent, or dull, moderate pain. Depends upon size of spleen.	Localized, or intestinal type (pressure of spleen).	Marked dragging; heavy feeling in left upper abdomen.	Absent, or sharp in splenic region, left upper quadrant.	.. Pain (type and radiation)
Normal, unless secondary infection.	Negative.	Normal or slight elevation. May be acute exacerbations.	Negative.	Temperature
Usually absent.	Absent.	Absent.	Absent, or moderate in left upper quadrant.	Abdominal rigidity
None, unless recent increase in size, infection or perisplenitis.	Absent, or slight over spleen.	Absent, or slight over spleen.	Absent, or moderate over spleen.	Abdominal tenderness
Contour of enlarged spleen, or irregular or rounded mass in splenic region. Fluctuant or tense.	Spleen enlarged, firm, regular. May be extremely large.	Hard, regular splenic enlargement. Often huge in size.	Enlarged spleen—firm, smooth, normal consistency; or hard, nodular, irregular, fixed, according to tumor.	 Mass
Negative, unless intestinal invasion also presents.	Negative.	Negative.	Negative.	 Stools
Secondary anemia in parasitic diseases.	Secondary anemia.	Leukocytosis marked. Myelocytes, myeloblasts, transitional cells.	Negative.	 Blood

DIFFERENTIAL DIAGNOSIS OF CONDITIONS CAUSING CHRONIC

Symptom	Aneurysm (Splenic and Renal Arteries; Thoracic Aorta)	Chronic Colitis	Banti's Disease	Chronic, Passive Congestion (Splenic)	Chronic Splenitis and Perisplenitis
Urine	Negative.	Negative.	Negative. May be signs of chronic nephritis.	Often albumin and casts.	Negative.
Special data	Very difficult to differentiate. Renal aneurysm may erode vertebræ and cause sensory and motor disturbances at lower levels. Dissecting aneurysm of thoracic aorta accompanied by chest signs, positive Wassermann, difference in blood-pressure in lower extremities. Fluoroscopy and x-ray plates. Signs and history of syphilis. Elevated blood-pressure. Palpable thrill. Bruit.	Idiopathic, parasitic, chemical (lead), infective. Rapid peristalsis upon fluoroscopy. Macroscopic evidences in sigmoid as well; sometimes rectum, also.	Gastric symptoms. Hematemesis, often early. Enlarged liver and ascites in late stages. Splenic enlargement greater and precedes that of liver, and may become very marked.	In association with chronic passive congestion of liver and lungs and kidneys (cardiac decompensation). Edema and ascites common.	A sequel of regional or splenic infection of various types; of parasitic diseases; of infarction; of injury.

See Chart, "Right Upper Quadrant" for Subphrenic Abscess; Intestinal Obstruction (Partial);
Mors and Cysts; Neurosis;

may be discovered only at the autopsy table. If of large size, or rapidly forming, symptoms of mass, weight and pressure on neighboring organs will be present.

Tumors

Malignant tumors are occasionally present. They are usually secondary to a malignant tumor elsewhere in the body and are rarely treated surgically.

Primary sarcoma is occasionally encountered. An enlarged and tender organ, firm and with a nodular and irregular outline, rapidly increasing in size, and in the absence of any known cause, should be looked upon with the suspicion of the possibility of sarcoma. Carcinoma is a surgical rarity.

PAIN IN LEFT UPPER ABDOMINAL QUADRANT (*Continued*)

Cysts and Parasitic Disease (Splenic)	Gaucher's Disease	Leukemia	Splenic Tumors	Symptom
Negative.	Negative.	Negative.	Negative.	 Urine
History of injury or infarction often precedes cyst formation. Nativity, blood examination important in some (<i>i.e.</i> , leishmaniasis). Multiple cysts occasionally with polycystic kidneys. Cysts may be movable.	Corresponds with Banti's disease, clinically, but at earlier age. A type of splenic anemia. Liver often enlarges.	Progressive weakness, loss of weight, gastric disturbances, mucous membrane hemorrhage.	Rare. Moderate or rapid growth, according to nature of tumor.	Special data

Chronic Pancreatitis; Hypernephroma; Renal Calculus; Gastric Ulcer; Retroperitoneal Tumor; Intercostal Neuralgia

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CHAPTER XXIII

LIVER; GALL-BLADDER; BILIARY DUCTS—JAUNDICE

AFFECTIONS OF THE LIVER

Malformations	transposition displacements congenital acquired hernia hepatoptosis
Injuries	rupture gunshot stab wounds
Infections	suppurative pylephlebitis abscess localized multiple amebic
Tumors	benign angioma adenoma cavernous hemangioma malignant primary carcinoma metastatic carcinoma primary sarcoma metastatic sarcoma metastatic hypernephroma
Cysts	dermoid congenital cystic liver cystic adenoma hydatid
Chronic passive congestion	
Granulomata	gumma actinomycosis tuberculosis
Cirrhosis	
Aneurysm of hepatic artery	

Examination of Liver

The liver occupies the right hypochondrium and a portion of the epigastric region. It lies behind the left fifth costal interspace extending to a point about four fingerbreadths from the median line. It lies behind the lower part of the sternum and the xyphoid appendage and behind the epigastric wall as far as the junction of the upper and middle thirds of the xypho-umbilical line. It extends from the fifth rib on the right side of the thorax to the costal margin, posteriorly from the lower

angle of the scapula to the twelfth rib and in the vicinity of the spinal column, from the eighth to the eleventh dorsal vertebræ.

Examination of the liver should begin by inspecting the organ from all angles and in all lights. The lower portion of the thorax should be viewed for fullness, bulging or abnormal protrusions.

Palpation of the liver can be carried out from below the costal margin by rolling the fingers upward beneath the lower border of the liver (Mathieu's procedure). If the liver is palpable, pathology is present. Percussion of the liver should be performed along a series of vertical lines, *i.e.*, the right parasternal, mammillary, axillary and dorsolumbar.

Percussion should be made from above downward against the fingers of the left hand placed flat over the liver region. A definite dullness rising above the fifth rib anteriorly or the angle of the scapula posteriorly, indicates an enlarged organ at its upper convex surface.

Malformations

Malformations of the liver may be congenital or acquired. The organ may be found in the left hypochondrium with transposition of all the abdominal viscera, or it may be herniated into the pleural cavity by congenital or traumatic absence of the diaphragm. *Hepatoptosis* is a condition characterized by a downward displacement of the liver, and often attended by marked mobility of that organ. It is not of great rarity and its edge has been noted in the pelvis. As a rule, it is part of a general visceroptosis. The symptoms are usually negligible—though there is often present a sense of abdominal dragging and fullness. The recognition of a liver edge which easily slips from under the fingers usually differentiates it from intra-abdominal tumors. Ptosis of other organs (Glenard's disease) is frequently associated with the condition.

Injuries

Injuries to the liver are usually the result of gunshot or stab wounds, but may follow a severe crushing, even though no ribs are fractured. Death soon ensues if the injury has been very severe; otherwise, a hematoma or extensive intra-abdominal bleeding is the result. Rupture of the stomach or intestines occasionally occurs with injury to the liver and clouds the clinical picture with peritonitis. C. S. White (*Surg., Gynec. & Obst.*, March, 1923, 36:343-347) aspirates the abdominal cavity with a large needle to determine if hemorrhage is present. He believes that vomiting is more conspicuous and the leukocyte count higher in perforation than in hemorrhage. Examination of the blood every hour for hemoglobin determination and red-cell count is very valuable. In doubtful cases, exploration is less fatal than severe hemorrhage. Infection from the wound or blood stream leads to the formation of liver abscesses or peritonitis. In many cases the escaping blood and bile cause an ascites followed by extensive adhesions.

Infections

Infections of the liver of surgical importance are abscesses, either multiple and secondary to pyelephlebitis, or localized, following infection of the gastro-intestinal or biliary tract, or amebic dysentery.

Suppurative pylephlebitis is an inflammatory condition of the portal vein, usually accompanied by innumerable suppurating thrombi throughout the vein, with accompanying multiple liver abscesses and with the clinical evidences of pyemia. The synonyms for this disease are *portal pyemia*, and multiple abscesses of the liver.

The condition occupies an important place in the diagnosis of surgical conditions, more as a complication than as a disease. The infection arises more commonly from certain parts of the body than from others, the appendix occupying the most prominent place. Next in order come the cecum, intestines, stomach and rectum, gall-bladder, local suppurative process of the peritoneum or subperitoneum, mesentery and spleen. It is comparatively rare. Pylephlebitis may be present when the patient is operated upon for the removal of an inflamed appendix, though it more often occurs after operation, perhaps in the course of a stormy convalescence. If this condition would more often be borne in mind after an appendical operation, especially in those cases which, pathologically, might suggest the possibility of subsequent portal vein infection, the probability of a more frequent correct diagnosis might be made and a symptom-complex considered. If, after a few days following the removal of a gangrenous appendix, especially of the retrocecal type, with or without the presence of pus, the patient should suddenly be seized with a severe chill, accompanied by a high temperature, we should naturally have in mind at least the possibility of a portal vein infection.

Conditions which might be confused with pylephlebitis are pneumonia, localized pericecal or pelvic abscess, acute pyelitis, subhepatic or lung abscess. We do not forget these conditions but pylephlebitis suggests itself strongly. The abdomen is inspected and palpated; no masses are noted. The abdominal breathing has not changed in character. There is no especial rigidity or tenderness. The patient is given an enema, perhaps a drastic cathartic, such as calomel. The lungs are examined and found apparently negative, no râles, no friction rubs, no consolidation. The leukocytes are high, perhaps 16,000. The urine is negative. There is no muscular spasm or tenderness over the costovertebral angle and the patient does not seem to be especially sick, no pain, no apparent disturbance whatever.

After a few days when the condition is definitely established, the morning hours show the patient to be happy, perfectly comfortable, and entirely undisturbed. The bowels have moved well, the tongue is clear, the temperature is normal, perhaps slightly subnormal, maybe 99° . On general principles, the lungs and abdomen are reexamined and are found to be apparently normal. The urine is negative and no costovertebral tenderness has developed. We examine the blood, believing we may possibly find a wandering malaria parasite or two. None is present. The patient may be hungry—he feels well. In the afternoon the nurse notes that there appears to be a slight restlessness on the part of the patient. He feels a little hot and traces of a flush are developing. The temperature is taken out of regular hours and there is a moderate rise (perhaps $101\frac{1}{2}^{\circ}$), as the afternoon progresses. The flush increases and more restlessness is noted, and then a sudden violent rigor ensues, followed by an intense sweating and a very moderate prostration. The temperature rises to 103° , 104° or 105° and for the time being the patient looks very sick. The interested and keen houseman will immediately take a fresh blood specimen. The blood is examined—fresh and prepared smears—no plasmodium is found.

There is no apparent change in the lungs or abdomen. A slight, and very slight, abdominal distention may be noted. The patient is feeling pretty well, though he is not hungry for his evening meal. He is tired out. The night is passed comfortably and in the early morning hours more or less restlessness is noted, and out of a clear sky, and perhaps before the morning meal, a severe chill followed by a very high rise of temperature ensues. The patient is sweating profusely and looks very sick. Pulse and respirations are rapid, the tongue is dry and perhaps nausea is present, vomiting occurs. A blood culture is taken, another blood examination made, both of which subsequently prove to be quite negative, though the leukocytes still remain high. The day passes, the temperature drops almost to a normal point. The abdomen still shows no untoward signs. There is not even a sign of localized rigidity. The next day passes without a chill, without more than a slight or moderate rise in temperature. The patient is quite happy and enjoys his food. By this time malaria, acute pyelitis, pneumonia, and a lung abscess can be ruled out of the diagnosis. So far our abdominal examination is negative. The patient wakes in the morning having had an extremely comfortable and peaceful night. He enjoys his morning meal, but toward noon he becomes flushed again; within a few moments a very violent rigor with profuse sweats ensues and he appears desperately sick. Within a few hours a chill, with an accompanying rise of temperature, again comes on. He is sweating most profusely and it seems as though there were a very slight tinge of yellow in the eyes. A little more abdominal distention is noted, though the bowels have moved well and no masses are noted in the abdomen; but the man is worse, and quite noticeably, too. "No, I have no pain at all, but I feel uneasy up here," and he points to the right upper abdominal quadrant and lower right anterior thorax. Upon palpation there is a very slight tenderness over the liver region. For a few days or weeks following, there is a repetition of what went on before. The patient is losing ground and we know that he is very sick. The liver is slightly enlarged and is more tender. Indeed, the spleen is palpable. Sweating is a marked feature and the chills and wide excursion of temperature are becoming so pronounced that we feel the diagnosis rests now between pylephlebitis and a subdiaphragmatic abscess. Radiographs are taken and there is but little displacement upward of the diaphragm. The signs and symptoms increase in their severity. The patient is almost prostrated but his freedom from much pain is pronounced. Indeed, he is not very unhappy, he's comfortable, but—he's dying.

Such is the history of a typical case of pylephlebitis.

Abscess.—Localized abscess of the liver may follow any infection of the gastrointestinal or biliary tract, an injury, an infected hematoma, foreign bodies in the stomach or erosion by gall-stones ruptured through the bladder wall. An *amebic abscess* of the liver is usually single, following an attack of amebic dysentery, even as long as two years before. The main symptoms are fever, usually slight, unless a mixed infection has occurred; sepsis with emaciation, weakness and toxic diarrhea; enlargement of the liver, more often the right lobe, with pressure on the diaphragm causing a convulsive cough; and pain, at first vague, later more severe, in the right hypochondriac region. Several years may pass without marked symptoms, or rupture into the pleural or peritoneal cavities may occur early. Rarely, rupture to the exterior takes place. Any of the microorganisms may be found in liver abscesses, though probably *B. coli* predominates. Even *B. aërogenes capsulatus* has been re-

ported with recovery. (C. C. Snyder, *Surg., Gynec. & Obst.*, May, 1924, 38:605-609.)

Tumors

Benign tumors of the liver are rare. Angiomata and adenomata are occasionally found during an operation on the gall-bladder, but they give no clinical symptoms. A large tumor diagnosed as pancreatic cyst by C. H. Peck (*Surg., Gynec. & Obst.*, Sept., 1921, 33:277-280) proved to be a cavernous hemangioma occupying nearly the entire left lobe and weighing 3 pounds 14 ounces. The symptoms were entirely mechanical.

Malignant.—*Primary carcinoma* of the liver is not common. It may occur as a massive growth, infiltrating and nodular, or associated with cirrhosis. There are no characteristic symptoms but a rapidly developing mass in the liver region, where malignancy elsewhere can be ruled out, is very suggestive of primary carcinoma. Secondary carcinoma is the most frequent tumor of the liver, following a carcinomatous embolism from the stomach, intestinal tract, ovary, uterus or elsewhere. The presence of such a tumor in the liver makes any case of carcinoma inoperable, hence the importance of careful examination of the liver before operation. Symptoms of a secondary liver carcinoma may appear rather abruptly with slight pain in the right upper abdominal quadrant, mild jaundice, ascites and a rapidly developing tumor mass in the liver region. These findings often overshadow the primary trouble. Metastatic sarcoma and hypernephroma have been reported, but are very rare.

Sarcoma may arise from the connective tissue of the liver, or as is usually the case, it is of secondary origin. A diffuse infiltration of the organ occurs, causing a generalized enlargement. Rapidity of growth, cachexia and an early developing ascites, with the presence of sarcoma elsewhere in the body, characterizes its appearance. In the young child, especially, this tumor should always be considered. The melanotic sarcoma is the type most usually found.

Cysts

Cysts of the liver are the dermoid, congenital, adenomatous or echinococcic. All of them are uncommon, but the latter is the most important from a diagnostic standpoint, such cysts occurring in one-half the cases of this affection. The parasite reaches the liver through the portal system, causing the formation of a cyst, which, upon reaching a certain size, contains daughter cysts and, by irritation, leads to the formation of adhesions and thinning out of liver tissue. Death of the contents of the cyst may take place or rupture into the abdominal or pleural cavities may occur.

Chronic Passive Congestion

Chronic passive congestion of the liver is of interest surgically only in differential diagnosis. It occurs in cases of circulatory disturbance and myocardial insufficiency, manifesting itself by a smooth, regularly enlarged, tender liver with edema of the legs, scrotum and possibly ascites.

Granulomata

Syphilis of the liver is of surgical importance only in the tertiary or gummatous stage. It is often mistaken for carcinoma, great care being necessary for a differentiation. A granuloma forms, becomes encapsulated in a fibrous tissue, loses its blood supply and undergoes caseation in the center. The gumma is a white or grayish-white mass, spherical, usually multiple, varying in size from that of a pea to an orange, discrete or fused together, and found in any part of the liver, but chiefly in the anterior middle portion. The entire area may be replaced by dense fibrous bands. Symptoms may be entirely absent, but where present, consist of a discomfort or real pain in the right hypochondrium with tenderness of the liver, general malaise, anemia, often fever, frequently ascites and rarely jaundice. There will be a history of primary and secondary stages of syphilis with a positive blood Wassermann reaction. In contrast to carcinoma, syphilis of the liver has slower development, does not attain such a large size, is accompanied by less pain and tenderness, is less likely to cause ascites and jaundice and diminishes under potassium iodid.

Actinomycosis of the liver is usually secondary to involvement of the intestinal tract, but may arise from direct extension or metastasis. The liver is enlarged; the clinical signs of abscess are present and confusion with syphilis and tuberculosis may result. Evidence of the disease elsewhere will be found; the pus contains the characteristic sulphur granules. Potassium iodid will cause a diminution in the tumor mass, but more slowly than in syphilitic infection.

Tuberculosis of the liver is very rare; when it does occur it is usually a part of a generalized, miliary tuberculosis. A few cases of single abscess have been reported. Diagnosis during life is uncommon.

Cirrhosis

Cirrhosis of the liver is, at times, treated surgically, and hence a short discussion of this condition should be included. It occurs in middle life, usually in men; often with a history of immoderate use of alcohol; at times in a person exposed over a long period to other toxins. In the earliest state the liver is slightly enlarged, but soon shrinks in size and is partially replaced by dense, white, fibrous connective tissue with islands of yellowish liver between. These fibrous bands have caused the name *hobnail* liver to be applied. When the blood supply becomes interfered with, a compensatory circulation is established; this takes place in four ways:

1. To the epigastric and mammary vessels, the caput medusæ about the umbilicus (Sappay).
2. To the esophageal and gastric vessels (Retzius).
3. To the hemorrhoidal and inferior mesenteric veins.
4. To the inferior vena cava by way of the mesenteric veins.

Marked cirrhosis may exist without symptoms. When the compensatory circulation fails, obstructive and toxic symptoms appear. There will be chronic catarrhal inflammation of the intestinal tract, nausea, morning vomiting, hemorrhage from the stomach, hemorrhoids, and most striking of all, *ascites*. Jaundice is usually slight,

the face thin, the eyes shrunken and the skin muddy. Toxic symptoms of delirium, stupor or coma may appear at any time.

Aneurysm of Hepatic Artery

Aneurysm of the hepatic artery is a very rare condition, the diagnosis of which is impossible before operation. As reported by M. Behrend, in *Surgical Diseases of Gall-Bladder, Liver and Pancreas* (F. A. Davis Co., Philadelphia, 1927), Tuffier opened an aneurysm of the hepatic artery while operating on what was supposed to be a hydatid cyst. Bleeding was so profuse that ligation of the artery proximal to the aneurysmal sac was necessary. Death followed in four days: there was no necrosis of the liver, death probably being due to an hepatic insufficiency.

AFFECTIONS OF THE GALL-BLADDER

Malformations	{	transposition	
		double	
		absence	
Injuries	{	gunshot	
		stab wounds	
		rupture	
Inflammatory conditions	{	acute cholecystitis	{ catarrhal
			purulent
		chronic cholecystitis	{ catarrhal (strawberry gall-bladder)
			purulent
		empyema	
		pericystic abscess	
Tumor	{	benign	
		malignant	{ carcinoma—rarely sarcoma
Calculi	{	cholelithiasis without symptoms	
		cholelithiasis with colic	
Hydrops			
Torsion			
Tænia			

The gall-bladder is a pear-shaped organ lying slightly above the tenth costal cartilage, and just at the outer edge of the right rectus muscle. A line drawn from the umbilicus to the right acromial process crosses the edge of the rib at the level of the gall-bladder.

Examination of the gall-bladder is seldom aided by inspection since the frequently associated liver enlargements obscure the gall-bladder.

Palpation of the gall-bladder may reveal a sense of fullness beneath the costal margin but the organ itself can never be felt, due to the overlying thick abdominal wall. *Robson's point* is of distinct value; this is the point of maximum tenderness in gall-bladder inflammation and is beneath the junction of the middle and lower

thirds of a line drawn from the right nipple to the umbilicus. Percussion and auscultation of the gall-bladder do not give diagnostic aid.

Malformations

Malformations of the gall-bladder are not frequent. Transposition with the other viscera has occurred. Double bladders, absence of the cystic duct and complete absence of the bladder itself have been reported, but are rarities.

Injuries

Injuries to the gall-bladder are very uncommon, being due to direct stab or gunshot wounds, rarely to indirect trauma and then only in such a case as the wheel of a loaded wagon or the like passing directly across the body beneath the costal arch. Bile escaping into the peritoneal cavity causes a localized peritonitis especially about the umbilicus (Ranschoff, *Tr. South. Surg. & Gynec. Ass.*, 1905). Normal bile is but slightly toxic, whereas infected bile causes a severe peritonitis. When the gall-bladder is wounded there is a tendency for the affection to become localized and to form a bile-draining fistula.

Inflammatory Conditions

Acute Cholecystitis.—*Catarrhal.*—Acute catarrhal cholecystitis is intimately associated with the same affection of the bile-ducts. See "Acute Catarrhal Jaundice."

Purulent.—Acute purulent cholecystitis is due to invasion by bacteria, most commonly the *B. coli*, *B. typhosus*, pneumococcus, staphylococcus and streptococcus. M. G. Peterman concludes that infection takes place in the majority of cases by the lymphatics rather than through the mucosa, since the mucosa is usually less involved, as shown microscopically, than the rest of the wall (*Surg., Gynec. & Obst.*, April, 1923, 36: 522-541). The gall-bladder is usually distended and tense, with early adhesions to neighboring structures. Pain of a severe paroxysmal type in the right hypochondrium is usually the first symptom. There follow nausea, vomiting, rise in temperature and pulse, chills, distention and extreme tenderness of the gall-bladder, rigidity of the right rectus muscle, especially in its upper half, and leukocytosis from 15,000 to 25,000. Jaundice is not as a rule present though a slight yellow tinge to the conjunctivæ is common. Rupture into the peritoneal cavity or intestinal tract or a chronic infection with abscess may be the result.

Chronic Cholecystitis.—*Catarrhal.*—Chronic catarrhal cholecystitis with erosion of the mucous membrane covering the apices of the villi has been termed *strawberry gall-bladder* from its resemblance to a ripe strawberry (W. C. McCarty, *Ann. Surg.*, 1910, 51: 651-669). There are yellow specks of desquamated cells scattered over the mucosa. In a large number of cases gall-stones are not present, symptoms arising entirely from the chronic cholecystitis. Such a condition may exist for years without giving symptoms or showing such mild ones that correct diagnosis is not made (E. S. Judd, *Collected Papers of Mayo Clinic*, 1916, Vol. VIII, p. 285). There is nothing to distinguish these cases clinically from acute catarrhal jaundice.

Purulent.—Chronic purulent cholecystitis usually follows an acute suppurative attack and may or may not be associated with gall-stones. The gall-bladder is distended, the walls thickened and usually densely adherent to the surrounding viscera. The symptoms will so closely mimic those of gall-stones that differentiation is often impossible. There will be attacks of “indigestion” with fullness and distention after meals, relief by belching, and often soreness in the gall-bladder region. Attacks of biliary colic may occur with severe pain in the epigastrium and right hypochondriac region, radiating to the right shoulder, slight fever, vomiting and distention, often requiring morphin for relief. Tenderness over the gall-bladder is the usual finding. X-rays, if not revealing stones, may show displacement and distortions due to adhesions.

Empyema of the gall-bladder is the result of either an acute or chronic purulent inflammation. The bladder becomes distended with pus, the walls thickened and often the mucous membrane completely destroyed. Symptoms will be similar to those of either an acute or chronic purulent cholecystitis (which see).

Tumors

Benign tumors of the gall-bladder are exceedingly rare, but deposits of lime salts in the wall as the result of chronic inflammation may simulate such a tumor.

Malignant.—*Carcinoma* of the gall-bladder is not common, but many cases have been reported. It seems to follow chronic irritation by gall-stones, for these are often found within the tumor mass (73-85 per cent). There will be a rapidly developing tumor found beneath the right costal margin, with the sense of discomfort and later actual pain, radiating to the back and right shoulder; at times no mass can be palpated. The tumor is hard and rarely tender, at first movable, later becoming fixed and more diffuse. There is involvement of the liver and possibly of the stomach and duodenum. The lymph glands at the hilum of the liver become enlarged, jaundice is, as a rule, not present at first, but is usually noticed as the condition extends. General failure in health and cachexia precede the fatal determination.

Calculi

The occurrence of gall-stones is common, but may cause no symptoms for years, or even for life. Fifty per cent occur in persons over forty, although several cases in children have been reported. Three-fourths of the cases are in females. The exact formation of the stones is not known but any condition which favors the stasis of bile in the gall-bladder aids in their development. Such conditions are lack of exercise, excessive eating, pregnancy, enteroptosis and constipation. Infection is frequently the forerunner of cholelithiasis, some writers even going so far as to state that all stones have their beginning in an infectious process within the gall-bladder. The *B. typhosus* is frequently the causative organism closely followed by the *B. coli*, streptococcus, and staphylococcus. There may only be one stone, ovoid and of large size; more frequently there are several stones from a few to several hundred, small, polygonal and faceted. Occasionally, dark mulberry-shaped stones are found. Each calculus contains a nucleus, usually made up of bile pigment, while the stone itself consists largely of cholesterin.

Symptoms of cholelithiasis may be entirely absent; a stone may even rupture into the intestinal tract where it causes obstruction without having given signs referable to the gall-bladder. When a stone attempts to pass from the bladder, violent symptoms will be present. In a general way when symptoms do occur, they are severe pain, collapse, and general body upsets. The pain comes on in paroxysms at irregular intervals, in the epigastrium and right hypochondriac regions, radiating to the back and right shoulder. Between attacks there may be a dull ache in this region with tenderness midway between the ninth costal cartilage and the umbilicus. The severe pain may come on without apparent cause, although frequently, exertion or the taking of food ushers in an attack which passes off after a time, with nausea and vomiting. The vomiting is at first stomach contents, later bile if the common duct is free; it may be very persistent and serious, leading to exhaustion. At times the pain is so severe that the patient will pass into a state of collapse, and death under such conditions has been reported. During the attack, a tumor mass in the region of the gall-bladder may be noted, especially in chronic cases, as the result of violent contractions of the thickened bladder wall. After an attack, gall-stones may be found in the stools, if a successful escape through the common duct was effected. If the stone blocks the common duct, jaundice will be a prominent symptom. See discussion under "Jaundice." Complications and sequelæ of gall-stones are numerous; the most common are peritonitis, adhesions, ulceration, perforation, gangrene, empyema or hydrops of the gall-bladder and abscess of the liver.

Hydrops

Hydrops of the gall-bladder follows an acute infection in which the organisms have been destroyed and the pus replaced by sterile serum and mucus. The organ is distended, but symptoms are only those of chronic cholecystitis or hepatitis. A history of an acute attack of cholecystitis several years before is an important aid in arriving at a correct diagnosis. A stone wedged in the cystic duct is often the etiologic factor.

Torsion

Torsion of the gall-bladder is very rare, the normal anatomic structure making it impossible for this condition to develop. A. M. Shipley (*Arch. Surg.*, May, 1927, 968-977) was able to collect only twenty-two cases, all except five being over sixty years of age and all but two women. In only one case was the gall-bladder perforated. The onset was sudden, with pain in the upper right abdominal quadrant and vomiting. There was some bloody serous fluid in the peritoneal cavity but little evidence of peritonitis, as the result of bladder necrosis. Shipley states, as follows: "It appears that biliary calculi do not play a part in torsion and that their presence in seven cases was incidental."

Tania

Round-worms are found frequently in the bile-ducts and gall-bladder, and Aviles reports a case of *Ascaris lumbricoides* in the latter region (*Surg., Gynec. & Obst.*, 1918, 27:459-461). E. B. Benedict found the *Tania saginata* in a gall-bladder while operating for acute cholecystitis (*J. Am. M. Ass.*, Dec. 4, 1926, 87:1917).

DIFFERENTIAL DIAGNOSIS OF COMMON CONDITIONS CAUSING CHRONIC PAIN IN RIGHT UPPER ABDOMINAL QUADRANT

Symptom	Chronic Appendicitis (Retrocecal)	Partial Intestinal Obstruction	Passive Hyperemia of Liver	Chronic Cholecystitis (with or without Stones)	Gall-Bladder Carcinoma	Ptosis of Liver	Chronic Ulcer of Duodenum or Stomach (Either Side of Pyloric Ring)	Tumors of Stomach or Duodenum
Age	Any. Rare before 2 and after 60. Most common 18-35.	Any. Mostly adults.	Any. Most especially in adult life.	Usually after 40.	Advanced.	Adult females.	Adult. Middle.	Any. More in middle adult life.
Pain (type and radiation)	Varied. More severe recent attacks may be similar to those found in the acute retrocecal cases. In chronic relapsing form and those types due to bands, kinks and adhesions, dull, dragging pain in some part of right iliac fossa, referred to back and loin and often to lower portion of upper abdominal quadrant with acute exacerbations, at times.	Variable. Fullness, bloated feeling or intermittent colicky pain, often worse at one point. Often related to eating. May be relieved by enemata.	Dull, dragging with sense of pressure in epigastrium and right upper quadrant, often increased upon motion or upright position. There is little or no actual pain—more of a heavy discomfort which is usually constant.	Indefinite, dull and dragging under liver region and often referred to epigastrium and right shoulder. Often increased by intake of food or quick movement of body. Occasionally increased by raising right arm.	In right upper quadrant. Often severe, usually localized.	Appears especially in upright position.	Character of pain is not characteristic and may be due to reflex spasm of pylorus or reflex through disturbances in other parts of abdomen.	Vague, indefinite, dragging type; sense of fullness; or severe and colicky, increased upon eating. Constant or intermittent.
Abdominal rigidity	Slight or marked over right iliac fossa, extending upward toward lower portion of right upper quadrant and backward toward right loin.	Absent or slight.	May be slight in epigastrium and right upper quadrant. May be entirely absent.	May be entirely absent. Often slight over gall-bladder region. In acute exacerbation, marked over right upper quadrant.	Moderate, in right upper quadrant.	Absent.	May be pronounced over appendiceal region. Usually slight over epigastrium.	Entirely absent; or moderate rigidity.

Abdominal tenderness	Dull pain on pressure over right iliac fossa, which is intensified by pressure in back.	Absent or slight.	On palpation and percussion over liver region, in epigastrium (most marked in linea alba, where liver most exposed).	None or slight over gall-bladder region. In acute exacerbation may be marked over right upper quadrant.	In right upper quadrant.	Over enlarged liver, at times.	Definite point of tenderness. Pressure may influence pain in epigastrium.	Variable.
Mass	Usually none. A small ill-defined swelling may be present in right iliac fossa, extending backward to loin.	Absent or present, depending upon nature of obstruction.	Liver enlarged and regular in outline.	None. May be temporary enlargement of gall-bladder.	In gall-bladder area; hard, irregular, elongated.	Below free costal margin, continuous with area of hepatic dullness. Firm, tongue-like.	All depends upon whether callosity has formed.	Sometimes palpable, in epigastrium and right upper quadrant. Varies with type of tumor.
Stools	Usually marked constipation. Negative.	May or may not contain blood and mucus. Increasing constipation; perhaps diarrhea.	Negative.	Usually negative. During exacerbation stools may be light or clay-colored.	Negative, or decrease in bile.	Negative.	Occult blood. Chemically, blood.	May contain occult or gross blood.
Special data	Three distinct forms: (1) Recurrent, characterized by repeated subacute or acute attacks, with intervals of freedom from any clinical evidence of disease. (2) Chronic relapsing, in which patient is never well and is subject to more or less acute exacerbations. (3) Residual condition, due to adhesions, kinks, etc. (Kelly). Dyspepsia and flatulence common.	Symptoms aggravated at certain periods, particularly in association with constipation, overeating and injudicious diet. Loss of weight in prolonged cases. Asymmetry of abdomen, visible peristalsis and excessive intestinal sounds to be noted. X-rays with barium by mouth and enema important.	Usually history of digestive disturbances, appendicitis, alcoholism, or cardiac derangement. Pulmonary affection may antedate condition. Hemorrhoids common. May be slight jaundice. Often improvement after cardiac treatment. May be signs of acute or chronic nephritis. Urobilinuria is marked.	Digestive disturbances of varying degrees. May be intermittent jaundice. May be definite history of an acute cholecystitis or acute ulcer of duodenum or pylorus. Typhoid fever history often present.	Jaundice usually develops. Indigestion. Progressive weight loss. Gradual increase in mass.	Faulty posture. Thin persons. Relaxed, protuberant abdomen. Pto- sis of other organs.	Often due to pyloric spasm (as reflex).	Some palpable, physical characteristics varying with type of tumor and changes in wall of viscus. May be visible peristalsis and gastric dilatation. Vomiting, indigestion, perhaps hematemesis. X-rays, including fluoroscopy.

DIFFERENTIAL DIAGNOSIS OF LESS COMMON CONDITIONS CAUSING

Symptom	Chronic Pancreatitis	Hypernephroma	Renal Calculus
Age	Especially middle adult life.	Any. Usually after 40.	Young adults. Adults. Old age.
Pain (type and radiation)	Related to eating. Usually moderate—sense of fullness, “bloating.”	Dull and dragging, especially in back and radiating to upper quadrants.	Between attacks of the typically acute pain, there may be a dull dragging, at times almost continually, in back, radiating down thigh to testicle or penis and to upper abdominal quadrant.
Abdominal rigidity	Absent, or slight, in right upper quadrant and epigastrium.	None.	Frequently none. Occasionally slight, in costovertebral region or upper abdomen, or both.
Abdominal tenderness	Absent or moderate, in same regions.	None.	Sometimes present at intervals. Frequent during attacks, in upper or lower quadrant.
Mass	Enlarged head of pancreas sometimes felt. Very firm, near epigastrium. Enlarged gall-bladder.	If of sufficient size, slightly irregular mass in loin and upper abdominal quadrant.	None, unless ureter is blocked, or kidney secondarily infected.
Urine	Negative or glycosuria.	Often blood and pus cells. Sometimes gross hematuria.	Occult blood or gross hematuria usually found. Pus cells when infected.
Special data ...	Often associated with gall-bladder disease and gall-stones. Diabetes sometimes associated. May be slight or fairly pronounced jaundice. May show presence of hyperglycemia. Stools, increased fat and large amounts of undigested proteins.	Bony tumor may be first symptom. At times digestive disturbances. Marked and progressive loss of weight and strength. Occasional vomiting. Seldom pigmentation. May be very high blood-pressure. Dyspnea may be present. Hematuria, renal colic from time to time. May be few or no local signs.	Intermittent attacks of renal colic, Dietl's crisis or painless hematuria. Clinical picture sometimes that of complications — pyelitis, pyonephrosis. Cystoscopy with ureteral catheterization and x-rays, important.

CHRONIC PAIN IN RIGHT UPPER ABDOMINAL QUADRANT

Retroperitoneal Sarcoma or Cysts	Neurosis	Subphrenic Abscess (Chronic)
Sarcoma in infancy and young adult. Not frequent after 45. Cysts middle.	Young adults. Middle.	Any.
In right upper quadrant, in loin, in back. Dull or sharp, neuritic pains in lower extremities.	Variable and vague. Atypical for ordinary organic affections.	Initial pain most marked in right upper quadrant, and often radiating to right shoulder; generally dull and deep-seated.
Absent or moderate in right upper quadrant and loin.	Voluntary spasm, but not true rigidity.	In upper right quadrant and epigastrium. Moderate or marked.
In right upper quadrant, extending downward or laterally.	At time of examination, it may be marked, but there is only voluntary muscle spasm accompanying it.	In upper right quadrant. Also frequent along intercostal nerves.
Deep-seated, irregular, varying consistency in adjacent areas, usually fixed. Cysts tense, and may be movable.	None.	May be an enlarged area of loin dullness, and palpable liver or mass.
Negative.	Negative.	Negative, unless of renal origin.
Rapid increase in size, if malignant. Constitutional symptoms. Mass overlaid by tympany. Location often confusing. X-rays of gastro-enteric and genito-urinary tracts aid in differentiation.	Multiplicity of symptoms. Suggestibility. Unstable nervous system. Diagnosis to be made only by exclusion.	X-ray, percussion note over liver (gaseous type). Liver lowered in position. Frequent association of a right sided pleurisy or even pleural neuralgia. Occasional jaundice. Temperature often of septic type with chills. Leukocytosis. Fluoroscopy.

AFFECTIONS OF THE BILIARY DUCTS

Injuries

Congenital anomalies { atresia
absence
malposition

Inflammatory conditions { acute catarrhal jaundice
acute suppurative cholangitis
acute ulcerative cholangitis
chronic catarrhal jaundice
chronic cholangitis

Foreign bodies

Parasites

Calculi

Stricture

Obstruction { intrinsic
extrinsic

Tumors { carcinoma

Injuries

Injuries of the biliary ducts, apart from surgical traumata, are not common. Strangely, the majority do not occur with simultaneous hepatic injury. A penetrating wound is the usual though not essential cause. Complete division or rupture of one of the ducts is accompanied by shock, nausea and vomiting, and the usual abdominal signs of injury. Rarely, bile may escape through a penetrating wound. Jaundice appears within two or three days, and there are signs of local or diffuse peritonitis. When the common duct has been divided, bile is found in the urine, and it gradually disappears from the stools. There are no immediate indications that the bile-ducts have been injured, but this surmise may be made on the subsequent course.

Congenital Anomalies

The common bile-duct may be congenitally obliterated or may be congenitally absent. In both conditions, jaundice is present at birth or appears shortly thereafter. It is characteristic that the jaundice is persistent and progressive. Digestive disturbances occur, the stools lack bile and the urine contains large quantities of bile. These features serve to differentiate these affections from the ordinary icterus of the newborn. Duodenal aspiration will fail to show bile.

Congenital alterations of size and position of the ducts also occur, but do not occasion clinical symptoms.

Inflammatory Conditions

Acute catarrhal jaundice is dependent upon an inflammatory process of the terminal portion of the common bile-duct, and subsequent plugging of this struc-

ture by mucus, usually at or about the papilla of Vater. Thus, it occurs as a complication of duodenitis; in the course of fevers, such as typhoid and pneumonia; and may be observed in epidemic form. The onset is acute, with gastro-intestinal disturbances, following which the patient becomes jaundiced. There is usually some upper abdominal discomfort, but real pain is not complained of. Fever accompanies the initial phase. Jaundice becomes deeper after a few days, and persists for a week or two, or even longer, its disappearance being very gradual. The liver may be enlarged. In correlating the pathology with the causation and clinical aspects, this type of jaundice when complicating the febrile diseases is more properly referred to as *acute catarrhal cholangitis*, reserving the designation "acute catarrhal jaundice" for those cases of duodenal origin.

Acute suppurative cholangitis is an infective process involving the principal bile-ducts, the liver and the intrahepatic ducts. It is associated, for the most part, with biliary obstruction, especially that caused by gall-stones; it may be caused by tumors and pancreatitis, which have become complicated by infection. The condition, as its name implies, consists of a purulent infection of the extrahepatic and intrahepatic ducts, often with extension to the liver parenchyma and with the production of multiple abscesses; frequently, too, from an extension beyond the confines of the liver, such as subphrenic or subhepatic abscess, pleurisy or empyema. It may follow appendical operations.

The onset is accompanied with fever and gastro-intestinal disturbances. Jaundice develops fairly quickly and gradually deepens. Usually there is pain in the liver region. Recurrent chills, followed by fever and sweating, are common and quite significant when considered in relation with jaundice, and there is gradual impairment of strength and loss of weight. The latter symptoms are progressive, sometimes at a rapid rate. Even when there are no rigors, the patient usually has profuse sweats. In late stages, delirium occurs. Objectively, the liver is found enlarged and tender, usually with gall-bladder distention, and subsequently with splenic enlargement. Leukocytosis is present. Rigors, profuse sweating, progressive emaciation and swinging temperature indicate sepsis. The jaundice and the abdominal findings usually indicate the source of infection. Diagnosis may rest largely upon the past history, as difficulty in the differentiation from hepatic abscess and pylephlebitis may be anticipated.

Acute ulcerative cholangitis represents a severe grade of suppurative cholangitis with ulcerations of the biliary ducts. It is a pathologic rather than a clinical gradation.

Chronic catarrhal jaundice and chronic cholangitis result from repeated acute attacks, or may be chronic in their production. These conditions are characterized by repeated attacks of vomiting, followed by jaundice and often with pain in the hepatic region. Some jaundice may be present at all times, with increase after each attack. The same etiologic factors mentioned in suppurative cholangitis may produce this relapsing type of jaundice or it may be dependent solely upon inflammatory or infective reactions.

Foreign Bodies

Foreign bodies cannot easily enter the biliary passages. Seeds may become impacted in the papilla of Vater and fishbones have been found in the common duct.

Thus, foreign bodies may produce either the symptoms of biliary obstruction or those of duct and hepatic infection.

Parasites

Parasites are also uncommon. They include the liver fluke, echinococcus and lumbricoides. These have been reported as lodged within the extrahepatic ducts, but parasitic obstruction is certainly a rarity. Secondary infection, of course, may be associated, so that symptoms of either biliary obstruction or of cholangitis may present.

Calculi

Biliary calculi may be formed within any of the biliary ducts or may lodge there after extrusion from the gall-bladder. Their future symptomatology is modified by size, situation, further attempts at extrusion and the presence or absence of infection. Very small stones may pass through any of the ducts without symptoms. Large stones produce either partial or complete obstruction and attempts at expulsion are accompanied by pain, which usually assumes the severe, upper abdominal type, with radiation to the right shoulder; gastric disturbances; upper right rectus rigidity and tenderness and relief only from morphin. Small stones at anatomically narrow sites, such as at the papilla of Vater and at the junction of the cystic and common ducts, will produce as severe symptoms and as great obstruction as larger stones in other situations. Infection is an accompaniment of gall-stones, and may cause diffuse cholangitis, which advances to a suppurative or ulcerative nature, in some instances.

Aside from the question of associated infection, the clinical picture of duct calculi is chiefly influenced by location. Calculous obstruction of the tortuous cystic duct results in dilatation of the gall-bladder. Retained bile is gradually absorbed and the gall-bladder becomes filled with clear mucus, producing a thin-walled distention of that organ (*hydrops* of the gall-bladder) which extends downward from the free costal margin and which may attain very large size. The enlargement retains, in general, the elongated, pearlike shape of the gall-bladder. If infection supervenes, a purulent cholecystitis or empyema of the obstructed organ is produced, with fever, nausea and vomiting, intense pain, muscular spasm, and marked tenderness. Jaundice is ordinarily absent, but sometimes occurs from pressure of a large calculus which has become wedged at the junction of the cystic and common ducts. It is usually slight in degree, and some bile is usually present in the stools.

Obstruction in the *common bile-duct* is usually accompanied by attacks of gall-stone colic which are immediately followed by jaundice. The stools are temporarily acholic, the urine contains bile and the jaundice varies in degree and duration. It is typical, however, that the jaundice comes and goes; and it is also the rule that the gall-bladder does not become enlarged. A very significant syndrome in calculous obstruction of the common duct is the recurrence of attacks of chills, fever and sweating, with or without simultaneous gall-stone colic. This is the intermittent hepatic fever of Charcot, and is associated with a ball-valve stone in the common duct, usually in the diverticulum of Vater. Pain may or may not be associated with the chills and fever. Jaundice is not constant in all instances of common duct

stones, and in some occurs only in minimal degree, a mere tinging of the scleræ. If calculus becomes wedged in duct, jaundice is constant and progressive. The stools remain clay colored.

Hepatic duct calculus cannot by itself cause signs of biliary obstruction, although simultaneous infection, with cholangitis, may do this. Digestive disorders, common to gall-stones in any situation, take place and propulsion of the stone along the duct causes attacks of pain. Cholangitis and biliary obstruction produce an enlarged liver in advanced gall-stone disease, with infection, with impaction of one or more calculi, or with both.

Diagnosis of gall-stone disease as related to the extrahepatic ducts include the elements of sex (female preponderating); age (early middle life); possible relationship to typhoid fever and pregnancies; obesity; the history of digestive disorders (chiefly distress after eating, fullness, flatulence); attacks of pain, which may resemble gall-stone colic; and the history or presence of jaundice. The physical findings as mentioned depend upon the location of the calculi. According to Courvoisier's law, the gall-bladder is rarely dilated in common duct obstruction by stone. The jaundice of gall-stones is not progressive, but varies in relation to attacks of colic, and is accompanied by pain in contrast to carcinomatous obstructions. Recurrent chills and fever in the presence of jaundice and the history suggestive of gall-stone disease are of great importance. Radiography demonstrates a small proportion of gall-stones and improved technic with intravenous injection of opaque salts serves as a modern and fairly satisfactory mode of investigation of the patency of the bile passages. The *van den Bergh test* occasionally will give indications of "latent" jaundice, before scleral and cutaneous changes have taken place.

Stricture

Strictures of the bile-ducts may be congenital; they may be the result of injury, as by the passage of a gall-stone; they may be induced by severe infective processes within the ducts; and they may be caused by syphilitic cholangitis. The symptoms are those of incomplete or complete obstruction, depending upon the extent and location of the stricture. The cystic duct with its winding channel is the most common site of stricture.

Obstruction

Obstruction of the principal bile-ducts may be caused by conditions of the ducts themselves; by obstructions within the duct lumen; or by pressure from without. The obstructions may be complete or incomplete. The location of the obstruction determines the pathologic and clinical sequence, which has been described under "Calculus." Obstructions from within the ducts include calculi, foreign bodies, infections, parasites, stricture, inflammatory conditions and new growths. Extrinsic causes include glands in the gastrohepatic omentum and fissure of the liver, abdominal aneurysm, carcinoma of the pancreas and duodenum, chronic pancreatitis, floating kidney, and hypernephroma, abdominal aneurysm, perihepatic adhesions, etc. (See "Jaundice.") Continued obstruction of the common duct other than by calculus usually results in dilatation of the gall-bladder. Infection may complicate any type of obstruction.

Tumors

Carcinoma.—Primary carcinoma of the bile-ducts occurs chiefly in men of middle age. The cystic and common ducts are the usual sites. Vague gastro-intestinal symptoms are the earliest indications, followed by loss of weight and strength, and in the case of common duct obstruction, by jaundice. This is also a somewhat retarded sign in cystic duct carcinoma which has infiltrated itself about the common duct.

When once jaundice appears, it gradually or rapidly increases without remission, until the skin becomes deeply bronzed or greenish-blue in appearance. Persistent jaundice of this type with enlarged gall-bladder, usually hepatic enlargement and indications of progressive cachexia combine to suggest malignancy. Pancreatic carcinoma cannot be differentiated unless there is a palpable mass. The most significant feature is complete, increasing and painless jaundice, bile-loaded urine, and acholic stools.

JAUNDICE

History

Age; Sex; Nativity

Family History.—Tuberculosis, cancer and other tumors, indigestion or gall-stones, kidney and heart troubles, “family jaundice,” syphilis.

Personal History and Present Illness.—Previous attacks similar to present illness, acute infectious diseases, including typhoid fever; syphilis, gonorrhea; alcohol and tobacco; indigestion or “stomach trouble”; eructations of gas; appetite; bowels, including constipation or diarrhea, changes in color of stools, before, during, or after an attack, constant or intermittent; change in color of urine, before, after, or during attack, constant or intermittent. Passing of stones by rectum; chills and fever; nausea and vomiting, and appearance and time of vomiting. Location, character and radiation of pain. Itching. Onset of attack, character and time. Indiscretion in diet. Duration of jaundice. Previous sojourns in foreign countries. Previous operations.

Physical Examination.—Nutrition and general appearance of patient; intensity of jaundice; mental state and facial expression; petechiæ or edema; pulse and temperature. Contour of abdomen, signs of muscular rigidity, pain on pressure and maximum point of tenderness, tumor mass and range of mobility of same, superficial vein enlargement. Examination of liver, spleen and lymph-nodes. Presence of intra-abdominal fluid. Urine, leukocytes and examination for malarial parasite. Widal. Stools. Blood-pressure. Wassermann test.

Definition.—Jaundice is a condition characterized by a yellowish discoloration of the tissues by bile pigment, the excretion of bile pigments in the urine, with or without bile acids, and by general symptoms referable in simple cases to disturbances of gastro-intestinal and liver functions; in more severe cases to a disorder of the blood as well as of the liver, caused by absorption of bile from the bile passages, as the result of impeded outflow.

Etiology.—Jaundice resulting from mechanical obstruction; jaundice dependent upon changes in blood and bile.

SIMPLE OBSTRUCTIVE JAUNDICE.—*Obstruction by Pressure on the Ducts from Without*

Tumors pressing on the cavity of ducts or growing into their interior	{	tumors projecting from liver
		enlarged glands in liver fissure
	{	gastric malignancy
		duodenal malignancy
	{	tumors or displacement of kidney
		pancreatic malignancy
	{	retroperitoneal or omental tumor
		abdominal aneurysm
	{	fecal accumulation
		pregnant uterus
	{	ovarian and uterine tumors
Inflammatory and cicatricial processes in parts adjacent to bile-ducts	{	duodenitis and cicatrization of duodenal ulcers
		perihepatitis
	{	chronic perihepatitis or pericholangitis and chronic
		pericholecystitis
	{	acute and chronic pancreatitis
		liver cirrhosis
Congenital or spasmodic conditions	{	congenital deficiency or stenosis of bile-ducts
		spasmodic stricture

Obstruction by Diseased Processes in the Walls of the Ducts

Cholangitis of all degrees, caused by	{	congestions
		excretion of irritant digestive products through bile
	{	infection

Malignant diseases and stricture of the bile-ducts

Obstruction in the cavity of the ducts	{	biliary sand and calculi
		mucus
		worms

JAUNDICE DEPENDENT UPON CHANGES IN BLOOD AND BILE

Caused by action of chemical poisons such as toluylendiamin, phosphorus, arsenic, snake bite.

Due to poisons formed in the various forms of gastro-intestinal intoxication.

Due to poisons formed in various specific fevers and conditions, such as yellow fever, malaria, pyemia, relapsing fever, typhoid and scarlet fevers.

Of unknown etiology such as acute yellow atrophy of liver, Weil's disease, blood conditions, etc.

INTERPRETATION OF HISTORY

Age

<i>Infancy and Childhood</i>	{	icterus neonatorum
		icterus gravis of children
		splenomegaly with anemia
		sarcoma of kidney
		Banti's disease
		congenital stenosis of common bile-duct
		congenital absence of common bile-duct
		congenital syphilis
		splenomegalic cirrhosis
		sarcoma of liver
		Hanot's disease

Young Adult Life { Banti's disease
local peritonitis
sarcoma of kidney
Weil's disease
acute yellow atrophy
sarcoma of liver
Hanot's cirrhosis
acute cholecystitis
gumma of liver
cholangitis, acute

Adult Life { carcinoma of gall-bladder
carcinoma of papilla of Vater
carcinoma of common bile-duct
carcinoma of stomach (pylorus)
carcinoma of duodenum
carcinoma of pancreas
acute pancreatitis
chronic pancreatitis
cholelithiasis
hypernephroma
gumma of liver
pernicious anemia
carcinoma of large intestine
pregnancy
carcinoma of liver
aneurysm (abdominal)

Old Age { carcinoma of liver
carcinoma of stomach
carcinoma of duodenum
carcinoma of gall-bladder
carcinoma of common bile-duct
carcinoma of pancreas
carcinoma of large intestine
cholelithiasis

Sex

Females Especially { acute yellow atrophy
pregnancy
ovarian tumors
omental tumors
cholelithiasis

Nativity.—This refers especially to parasitic diseases of liver.

Present Illness.—*Previous Attacks Similar to Present Illness.*—If the disease is one which presents exacerbations from time to time, the following should be considered:

Cholelithiasis
Cholecystitis
Pernicious anemia
Active and passive congestion of the liver
Acute jaundice of pregnancy
Acute gastro-enterohepatitis
Chronic cholangitis

Acute Infectious Diseases Including Typhoid and Yellow Fevers {
cholelithiasis
acute cholangitis
chronic cholecystitis
abscess of liver

Syphilis and Gonorrhea {
syphilis of liver
acute cholangitis
abscess of liver
aneurysm (abdominal)

Alcohol and Tobacco {
chronic pancreatitis
aneurysm (abdominal)
acute pancreatitis
active congestion of liver
passive congestion of liver
acute hepatitis
acute cholangitis
cirrhosis of liver
chronic pancreatitis
catarrhal hepatitis
Hanot's cirrhosis

Change in Color of Urine.—This symptom should be included with “bile in urine” but the patient is more prone to say that his or her urine has changed in color rather than to say there is “bile in the urine” and it is for that reason that this heading is taken up separately.

The appearance of bile or bilirubin in the urine is almost constant in jaundice, due to mechanical obstruction.

Passing of Stones by Rectum.—Patients suffering with gall-stones occasionally give the above symptom.

Chills and Fever.—Especially found in Hanot's cirrhosis, gall-stones, parasitic diseases of liver, abscess of liver, acute cholangitis, pyelephlebitis, acute pancreatitis, Weil's disease, epidemic infective jaundice.

Change in Color of Stools.—The change in color of stools from their normal appearance to that of a light yellow or putty color depends upon the interference with the flow of bile through its normal channels, rather than upon the change of blood constituents which so often gives rise to a so-called “jaundice.”

The length of time in which we may have a change in the color of the stools is also an important factor in the diagnosis of these conditions, and in history taking it should be inquired into with the greatest of care.

It must be borne in mind that a change in the color of the stools is but a link in a long chain of evidence, and that a variety of conditions, which subsequently may cause, let us say, a “putty-colored stool,” may exist long before this symptom appears. Going on the premise, however, that a change in the color of the stools is the symptom in question, what are the conditions which may cause that condition? And we answer, “Any pathology within or without the ducts, so extensive in nature as to prevent the normal flow of bile through the papilla into the intestines.” All grades of obstruction may exist, and in like proportions we have all grades of change in the color of the stools; when we have, thus, an entirely clay-colored stool, we have a complete obstruction to the flow of bile, which may be permanent or temporary. The following conditions are most important:

Congenital obliteration of the bile-ducts.

Complete congenital stenosis of the hepatic ducts, common bile-duct or of the papilla of Vater.

Wedged stones in both hepatic ducts.

A wedged stone in common bile-duct and carcinoma of common bile-duct.

A complete cicatrization of the common bile-duct following ulceration.

An extensive acute inflammatory condition of the ducts.

A wedged stone in the papilla of Vater and carcinoma of papilla.

Spasmodic contraction of common bile-duct.

Chronic pancreatitis and carcinoma of pancreas.

Any gland or tumor pressing upon the bile channels in such a way as to prevent the passing of bile into the intestines, the most frequently found being carcinoma of the head of the pancreas, carcinoma of common bile-duct, carcinoma of the duodenum.

If, on the other hand, there is only a partial obstruction from within or without the ducts, we have only a partial obstruction to the flow of bile and hence only a partial change of color, let us say, to a "light yellow." A most extensive jaundice may be, and is, very frequently present without the slightest trace in the change of color of the stools.

The constant appearance of a "clay-colored stool" is usually indicative of a stone wedged in the hepatic ducts, common bile-duct or papilla of Vater, a congenital obliteration of the bile-ducts, an advanced malignant condition of the common bile-duct, the papilla of Vater, gall-bladder, duodenum or pancreas, the most frequent probably being the pancreas.

The intermittent appearance of "clay-colored" or "very light-colored" stools is generally due to one of the following conditions: Calculi in the gall-bladder with exacerbations of inflammatory conditions of the bile-ducts, an acute catarrh of the bile-ducts with perhaps a gastro-enteritis, a "ball valve" common bile-duct calculus, a malignancy of a portion of the liver and biliary tract which *per se* has not grown sufficiently to cause obstruction but causing exacerbations of inflammatory conditions of the ducts, a spasmodic contraction of the common bile-duct, a secondary ulceration of a carcinoma of common bile-duct or papilla of Vater and chronic pancreatitis.

Nausea and Vomiting.—These are extremely common in about all the conditions in which jaundice is present, though the following diseases are most likely to cause these symptoms:

- Local peritonitis
- Acute cholecystitis
- Acute hepatitis
- Acute pancreatitis
- Cholelithiasis
- The jaundice caused by poisons

Itching is one of the constant signs of jaundice.

Indiscretion in Diet.—Often precedes an acute catarrhal hepatitis in combination with an acute gastro-enteritis; often precedes acute cholecystitis also.

PAIN IN JAUNDICE

Disease	Present	Character	Radiation
Peritonitis (local)	+	Acute-sharp	Over area involved and over abdomen.
Tumors of gall-bladder	±	Dull	Gall-bladder region. Perhaps to right shoulder.
Tumors of stomach	±	Dull	Upper abdominal quadrants, over abdomen, back.
Tumors of duodenum	±	Dull	Upper abdominal quadrants, over abdomen, back.
Tumors of pancreas	±	Dull	Upper abdominal quadrants.
Tumors of colon	±	Dull	Over abdomen, over site of lesion.
Tumors of right kidney	±	Dull	Over right lumbar, right upper, right lower quadrants.
Tumors of liver	±	Dull	Right upper abdomen, right shoulder.
Gall-stones	+	Acute-sharp	Right upper abdomen, right shoulder, abdomen, epigastrium.
Acute pancreatitis	+	Acute-sharp	Epigastrium, abdomen.
Chronic pancreatitis	±	Dull	Right upper quadrant and epigastrium.
Hanot's cirrhosis	±	Dull or absent	Over liver region.
Liver abscess	±		
Icterus neurosa	—		
Pernicious anemia	—		
Acute yellow atrophy	—		
Pylephlebitis	±		
Poisons	—		
Weil's disease	—		
Banti's disease	—		

Previous Sojourn in Other Countries.—This refers especially to the parasitic diseases of the liver.

Physical Examination.—*Appearance of Patient.*—The vast majority of patients who are jaundiced to a minor, or even a very marked degree, retain for a long period their rotundity and general “good health.” This is often found in some of the most severe cases of pernicious anemia. When one sees a patient who is thin and emaciated, especially if there is a marked degree of jaundice, malignancy has to be the first consideration.

The deep lemon hue of a pernicious anemia, and the deep brown color of a carcinoma of the head of the pancreas, or of an impacted stone of the common bile-duct, are the two extremes.

Presence of Intra-abdominal Fluid.—This is generally present in the atrophic form of cirrhosis, and is often found in the intra-abdominal malignant conditions.

ABDOMINAL SIGNS OF JAUNDICE

Disease	Abdominal Contour	Muscular Rigidity	Pain on Pressure	Tumor	Superficial Veins
Peritonitis (local) ..	Regular or irregular	+	+	If present, over right upper abdominal quadrant.	May be enlarged when there is pressure on portal vein by tumor including enlarged liver) or involved gland.
Tumor of gall-bladder	Regular or irregular	±	±	If present, over right upper abdominal quadrant.	
Tumor of stomach...	Regular or irregular	±	±	If present, over the epigastrium.	
Tumor of duodenum.	Regular or irregular	±	±	If present, over right upper abdominal quadrant.	
Tumor of pancreas...	Regular or irregular	±	±	If present, over the epigastrium.	
Tumor of colon.....	Regular or irregular	±	±	Depending on site of tumor.	
Tumor of right kidney	Regular or irregular	±	±	Right lumbar.	
Tumor of liver.....	Regular or irregular	±	±	Right upper abdominal quadrant.	
Gall-stones	Regular	+	±		
Acute pancreatitis...	Regular distention	+	+	Perhaps epigastric bulging	
Chronic pancreatitis.	Regular	±	±		
Hanot's cirrhosis ...	Regular	±	±	Over liver region.	
Atrophic cirrhosis ..	Ascites	±	—	Liver smaller.	
Acute yellow atrophy	Regular	—	—	Liver smaller.	
Liver abscess	Depends on size	+	±	Enlarged liver.	
Pernicious anemia ..	Regular	—	—		
Pylephlebitis	Regular	±	±	Enlarged liver.	
Poisons	Regular	—	—		
Weil's disease	Regular	—	—	Enlarged liver.	
Banti's disease	Regular or irregular	—	—	Enlarged liver and spleen.	

Urine Examination.—Any of the above conditions may present albumin and bile which must be bilirubin. The presence of sugar may aid in the diagnosis of the pancreatic diseases.

Leukocytosis is usually present in acute cholecystitis, empyema of gall-bladder, acute cholelithiasis with an accompanying inflammation, abscess of liver, acute cholangitis, acute hepatitis, Weil's disease, pylephlebitis, acute inflammatory processes of the biliary passages and the acute infectious diseases, excluding typhoid fever.

Wassermann test, positive, aids in the diagnosing of syphilis of liver, the congenital abnormalities, and perhaps atrophic cirrhosis.

Fever

Gall-stones with inflammation

Hanot's cirrhosis

Parasitic diseases of liver

Acute pancreatitis

Epidemic infective jaundice

Liver abscesses

Pylephlebitis

Acute cholangitis

Weil's disease

CHAPTER XXIV

THE BLOOD IN RELATION TO SURGICAL AFFECTIONS

There are a few blood examinations which are diagnostic *per se*. The major portion of such investigations, however, merely affords additional data which are to be construed in the light of other clinical information. This, in general, must be the attitude of the surgeon. Some laboratory findings undoubtedly influence the final decision; some corroborate a preformed opinion, either by their positive or negative character; some supplement intelligently the conception of a given condition; while others must be given little emphasis.

The Leukocytes.—One of the most valuable examinations from the viewpoint of the surgeon, is the leukocyte count. This is utilized chiefly as an index of suppurative conditions, and also as a measure of resistance to infections. In acute intra-abdominal affections, the leukocyte count is of great value. A high count usually coincides with a surgical lesion of infective origin. A low count suggests that the process is of low grade; that it is not of infective nature; that the individual's resistance is below par; or that one is dealing with a non-surgical condition, such as typhoid fever, influenza and simple gastro-intestinal disturbances. In practically all regions of the body, information can be obtained from this type of examination, particularly in acute processes. In lymphatic leukemia, for example, it is diagnostic. It is often necessary to know the character of the predominating cells, as well as the gross count, in order to make the proper interpretation. A relative increase in polymorphonuclear or mononuclear cells may be of as great significance as a considerable increase or decrease in the total count. Surgical diagnosis must take into account many conditions which are not surgical and, here again, the type and number of the leukocytes may be essential factors in exclusion. The usual findings will be indicated in some of the more common and important conditions which the surgeon may encounter. In this connection, the infection will be understood to refer to invasion by the pyogens.

Leukocytosis is usually present in abscess of the brain: polymorphonuclear increase is almost constant, regardless of the total count. There is also leukocytosis in acute cerebrospinal meningitis, infective meningitis, subdural abscess, acute mastoiditis and sinus affections, carbuncle, cellulitis, infected wound, erysipelas, acute osteomyelitis, in Ludwig's angina, acute lymphadenitis, cervical abscess, acute thyroiditis, and thyroid gland abscess.

Thoracic wall infections, mammary abscess, acute osteomyelitis of the bony thorax, including the vertebra; empyema, lung abscess and pneumonia; acute pericarditis and acute pleurisy including the diaphragmatic type are all accompanied by leukocytosis.

It is also found in subphrenic, perinephritic, pericecal, pelvic and other varieties of intra-abdominal abscess; in hepatic and splenic infections and abscesses; in acute

peritonitis from any source; in acute cholecystitis and other inflammatory conditions of the biliary tract; in acute appendicitis, acute pancreatitis, pelvic inflammatory disease including pyosalpinx; in acute intestinal obstruction, ruptured ectopic pregnancy; mesenteric thrombosis; in infected ovarian, mesenteric and peritoneal cysts; in urethral and renal infections; in prostatic and perirectal abscesses; in diverticulitis and in urinary extravasation.

Physiologic leukocytosis is met with in pregnancy and sometimes during menstruation.

In the lymphatic system, leukocytosis occurs in infectious abscess formation. This pertains to the nodes of the neck, axilla, groin, mediastinum and retroperitoneum. The count is unusually high in lymphatic leukemia.

Soft tissue, articular and osseous infections in any location are accompanied by leukocytosis.

Syphilitic and tuberculous processes, unless secondarily infected, do not cause leukocytic increase. The same is true of ordinary cysts.

Vascular conditions, such as septicemia, pyemia, the leukemias and infective thrombophlebitis and arteritis cause leukocytosis; also, infective processes in joints.

Increase in the leukocytes may be noted in various secondary anemias.

Leukopenia is met with in typhoid fever, influenza, malaria and tuberculosis.

The Erythrocytes.—Increase in number is unusual. The most striking erythrocytosis is encountered in polycythemia vera. Decrease accompanies hemorrhage, secondary and primary anemias. Alterations in shape, size and staining reactions aid in the differentiation of the anemias and indicate the extent of blood destruction.

The Hemoglobin.—Estimation of the hemoglobin content of the blood is important in relation to other blood findings. From this and the red blood-count, the color index may be estimated. This index is less than one in secondary anemias, and equal to or greater than one, in primary anemias.

The Differential Count.—By means of stained smears of the blood the various types of white and red blood-cells may be recognized; the relative number of blood-platelets can be estimated; and blood-cell parasites, *e.g.*, *Plasmodium malarie*, can be identified.

Red Cells.—These show changes in shape, size and staining reactions. In primary and in severe protracted secondary anemias, there are frequently nucleated red cells of approximately normal size (normoblasts) or of increased size (megablasts). The course of such anemias and the response to treatment can be followed accurately by means of repeated stained smears as these changes in the cells indicate both the extent of blood destruction and the attempt at new cell formation. Secondary anemia occurs after hemorrhage, in syphilitic, tuberculous and malignant diseases, in malaria, various splenic and hepatic enlargements and after many of the acute or prolonged infections.

White Blood-Cells.—Polymorphonuclear increase occurs in infectious processes; also in chemical and thermal injuries. Lymphocytosis is found in tuberculosis, syphilis, malaria and typhoid fever. Great increase in small mononuclear cells is found in lymphatic leukemia, while preponderance of large mononuclear and transitional cells characterizes myelogenous leukemia. Eosinophilia occurs in parasitic affections and sometimes in Hodgkin's disease. There is, however, no typical blood-picture in Hodgkin's disease. Immature white blood-cells (myelocytes,

myeloblasts, mast cells and transitional cysts) appear in leukemia and some of the primary anemias, particularly those of children.

The Platelets.—These have little significance in surgical diagnosis. The most marked variation occurs in chlorosis, in which there is a great increase in blood-platelets.

Coagulation Time.—This is of surgical importance when operations upon patients with various conditions is contemplated. The coagulation time should always be estimated in suspected hemophiliacs; also, prior to operation, in jaundiced patients in the leukemias and primary anemias, especially in children; prior to splenic and blood-vessel surgery; and whenever the history of prolonged bleeding has been given.

Blood Cultures.—These are of considerable aid in determining the existence of typhoidal, septicemic and pyemic conditions. Organisms are often released into the blood stream in showers, requiring repeated cultures before they can be obtained. A single negative culture, therefore, has no significance.

The Widal Reaction.—This agglutination test is used in suspected typhoid and paratyphoid fevers; as a rule there is no positive agglutination during the first week of the disease.

Fresh Blood Examinations.—These are used in the identification of malarial parasites, the spirochetes of relapsing fever, the *Filaria sanguinis hominis* and the Leishman-Donovan bodies. Stained preparations are also advantageous.

The Wassermann and Kahn Precipitation Tests.—In surgical practice, these tests are used to identify lesions as syphilitic, or to rule out syphilis in conditions which are obscure. Since the manifestations of syphilis are numerous, often mimicking other affections, these tests have gained a position of importance. Negative and suspicious reactions should be repeated.

The Blood Groups.—Blood grouping and matching are preliminary investigations which must be completely performed prior to transfusion operations. To summarize a complex problem, the most dependable procedure is direct matching of the blood of both donor and recipient, matching cells against serum and serum against cells. The human race is classified as comprising four great blood groups designated by the numbers one to four. Group 1 is composed of "universal donors," individuals whose blood is compatible with those of all other groups; the blood of donors in Group 2 is compatible with members of the same group and with those of Group 4; the blood of Group 3 donors is satisfactory for members of Groups 3 and 4; and that of Group 4 donors only for members of the same group.

Chemistry of the Blood.—In general, the chemical constituents of the blood are of more interest to the internist than to the surgeon. The adoption of standard estimations of the various chemical bodies, and of standardized methods of determination, have supplemented the clinical data of certain problems, notably nephritis and diabetes. Although these are, for the most part, medical conditions, yet they often assume a more important rôle than a presenting surgical condition, and are therefore factors to be seriously reckoned with.

Sugar.—Normally, the blood contains 0.09-0.12 per cent of sugar. Increased sugar content, or hyperglycemia, occurs chiefly in diabetes. It may also be found in acute and chronic pancreatitis, tumors and cysts of the pancreas, cerebral tumors, pituitary enlargements and acromegaly and Graves's disease. Hyperglycemia may

exist without glycosuria. In threatened or actual diabetic coma, the blood sugar reaches unusually high percentage.

Carbon dioxid combining power of content of the blood is a chemical indication of the degree of alkalinity of the blood, and is thus an index of acidosis. Acidosis occurs in numerous conditions, such as eclampsia, gastro-enteritis of childhood and diabetes.

Chlorids (sodium chlorid) of the blood become altered in various acute diseases, and in certain types of chronic nephritis. The surgical condition which is associated with chlorid reduction is acute intestinal obstruction, particularly high obstruction.

Urea, non-protein nitrogen and creatinin determinations have their greatest value in cardiorenal measures of kidney insufficiency or inefficiency, and of blood retention of toxic substances. They are of interest because of the importance and frequency of renal conditions in surgery, and because many surgical conditions are accompanied by increase of these toxic elements in the blood. In most of the latter instances, the explanation is that the kidneys have been damaged by the toxins of the surgical condition, for example, acute intestinal obstruction.

The following table from Myer's textbook, *The Chemical Analysis of the Blood*, shows the normal and beginning pathologic percentage values of the important chemical constituents of the blood.

	Urea Nitrogen	Non-Protein Nitrogen	Creatinin	Sugar Per Cent	Carbon Dioxid	Chlorids, Per Cent
Normal	12-15 mg. to 100 c.c.	25-35 mg. to 100 c.c.	1-2 mg. to 100 c.c.	0.09-0.12	50-75 c.c. per 100 c.c	0.45-0.50
Beginning pathologic..	20 mg.	35 mg.	3.5 mg.	0.15	— 45 c.c.	0.52

Bile Pigments in the Blood.—The van den Bergh test for bile pigments in the blood is based on the assumption that a certain concentration of these pigments in the blood is necessary before bile appears in the urine or jaundice develops in the skin and scleræ. This “latent” jaundice can be demonstrated at times by means of this reaction. The van den Bergh test is complicated, both “direct” and “indirect” phases being noted, and attempts being made, accordingly, to distinguish between hemolytic and obstructive types of jaundice. To be combined with this test is an estimation of the icterus index. The index is expressed in numbers, and anything over six is pathologic.

The Spinal Fluid.—Lumbar puncture, with examination of the spinal fluid, is often utilized as a diagnostic and therapeutic measure. Among its applications are included cases of fractured skull, subdural hemorrhage, meningitis, hematorachis, poliomyelitis, tumors and neurosyphilis. The color, consistency, turbidity and pressure are noted; the cell count and sediment examined; the globulin tested; and the Wassermann and colloidal gold reactions applied.

INDEX

- Abdomen, Chap. XIV, 552; Chap. XV, 567
 - acute conditions of, examination in, 553
 - — history in, 552
 - — — interpretation of, 556-559
 - auscultation of, 7
 - examination of, 626, 627
 - general considerations in, 552
 - injury to, 567-569
 - inspection of, 553
 - palpation of, 5, 554
 - percussion of, 6, 556
- Abdominal aorta, rupture of, 576
- Abdominal enlargement, differential chart of
 - affections causing, 604, 605
- Abdominal pain, after injury, 569
 - differential charts of. *See* regional charts in Contents.
- Abdominal rigidity, aneurysm of thoracic aorta in, 708
 - appendicitis, acute, 648
 - — — retrocecal, *facing* 721
 - — — chronic, 654, 722
 - cholecystitis and, acute, *facing* 721
 - — — chronic, 722
 - colitis and chronic, 664, 708
 - coronary thrombosis and, 694
 - diverticulitis and, 664
 - ectopic pregnancy and, 694
 - enterocolitis and, acute, 648
 - gall-bladder perforation and, 696
 - gastro-enteritis and, acute, 694
 - gastro-intestinal perforation and, 696
 - hernia and, strangulated, 653
 - hip tuberculosis and, 653
 - intestinal obstruction and, 649, 694
 - mesenteric tear and, 696
 - omental torsion and, 649
 - ovarian cyst torsion and, 652
 - pancreatitis and, acute, 690, 694
 - passive hyperemia of liver and, 722
 - peritonitis and, acute, 696
 - Pott's disease and, 665
 - pregnancy and, extra-uterine, 652
 - pyelitis and, acute, 648
 - salpingitis and, acute, 653
 - sigmoid carcinoma and, 665
 - splenic tumors and, 709
 - splenitis and, chronic, 708
 - typhoid ulcer and, 649
- Abdominal signs in jaundice, 736
- Abdominal symptoms in pneumonia, 184
- Abdominal tenderness, aneurysm of thoracic aorta and, 708
 - appendicitis and, acute, 648
 - — — retrocecal, *facing* 721
 - — — chronic, 654, 723
 - Banti's disease and, 708
 - cholecystitis and, acute, 719, *facing* 721
 - — — chronic, 720, 723
 - colitis and, chronic, 664, 708
 - coronary thrombosis and, 694
- Abdominal tenderness, diverticulitis and, 664
 - ectopic pregnancy and, 694
 - enterocolitis and, acute, 648
 - gall-bladder perforation and, 696
 - gastro-enteritis and, acute, 694
 - gastro-intestinal perforation and, 696
 - hip tuberculosis and, 653
 - intestinal obstruction and, 649, 694
 - leukemia and, 709
 - mesenteric tear and, 696
 - omental torsion and, 649
 - ovarian cyst torsion and, 652
 - pancreatitis and, acute, 690, 694
 - passive hyperemia of liver and, 723
 - perigastric abscess and, 616
 - peritonitis and, acute, 696
 - Pott's disease and, 665
 - pregnancy and, extra-uterine, 653
 - pyelitis and, acute, 648
 - pyelephlebitis and, 715
 - salpingitis and, acute, 653
 - sigmoid carcinoma and, 665
 - spleen and, affections of, 708, 709
 - strangulated hernia and, 653
 - typhoid ulcer and, 649
- Abdominal wall, Chap. XVI, 578
 - actinomycosis of, 580
 - affections of, 578
 - carbuncles of, 578
 - cellulitis of, 578, 579
 - contusion of, 571
 - cysts of, 580
 - furuncles of, 578
 - granulomata of, 580
 - hematomata of, 580
 - inflammatory conditions of, 578
 - intra-abdominal injury of, 572-576
 - tuberculosis of, 580
 - tumors of, 581
 - weakness of, hernia and, 586
- Abducens nerve, injury of, 65
- Abortions, repeated, laceration of cervix in, 304
 - internal myomata and, 299
 - uterine rupture causing, 298
- Abrachia, 333
- Abscess, 14
 - anal, 669
 - axillary, 159
 - bone, bone cyst as complication of, 397
 - — tuberculosis and, 389
 - brain, 71
 - breast, 169
 - Brodie's, 388
 - cerebral, skull fracture complicated by, 447
 - face, 82
 - hip joint, 350
 - humeral, 337
 - hydrocele differentiated from, 263
 - intrarectal, 669

- Abscess, ischiorectal, 669
 —kidney, 210
 —lip, 99
 —liver, 715
 —lymphadenitis and, acute, 534
 —mediastinal, 193, 194
 —muscle, 335 543
 —neck, 119
 —ovarian, 286
 —pancreatic mass in, 693
 —parotid gland, 92
 —penial, 250
 —perigastric, 616
 —perinephritic, 211
 —perirectal, 669
 —periurethral, urethral calculus and, 257
 —pouch of Douglas, uterine displacement caused by, 298
 —prostatic, 235
 —psaos, inguinal region swelling caused by, 598
 —pulmonary, 182
 —rectal, pain in, 669
 —retromammary, 169
 —retropharyngeal, 121
 —salivary gland, 121
 —scrotal, secondary to urinary extravasation, 262
 —secondary, in acute lymphangitis, 534
 —seminal vesicles, 238
 —space of Retzius, 579
 —splenic, 702
 —stomach, 615
 —submental gland, 122
 —subpericranial, of scalp, 48
 —subperiosteal, of skull, 55
 —subphrenic, *facing* 721, 725
 —thoracic wall, 151
 —thyroid gland, 120, 136
 —tongue, 106
 —tuberculous, in lumbar region, 212
 —umbilical, 582
 Accessory thyroid glands, 141
 —ovarian, 141
 —thoracic, 141
 Acetabulum, fractures of, 492, 495
 Achilles tendon rupture, 355
 Achillobursitis, 360
 Achlorhydria, 616
 Achondroplasia, 351, 393
 Achylia gastrica, 616
 Acromegaly, 394, 416
 Acromioclavicular joint, inflammation of, 331
 —tuberculosis of, 332
 Acromioclavicular ligament, subcutaneous rupture of, 326
 Actinomycosis, abdominal wall and, 580
 —anus and, 670
 —appendix and, 647
 —as granulomatous infection, 23
 —axilla and, 161
 —bone and, 389
 —brain and, 75
 —breast and, 174
 —cecum and, 657, 661
 —cervical lymph glands and, 133
 —cubital lymph glands and, 337
 —face and, 82
 —jaw and, 111
 —kidney and, 112
 —large intestine, 661
 —lung and, 185
 —mediastinum and, 194
 —meninges and, 75
 —muscles and, 544
 —ovary and, 289
 —parotid gland and, 92
 —penis and, 253
 —rectum and, 670
 —relation of occupation to, 82
 —shoulder and, 329
 —small intestine and, 637
 —stomach and, 621
 —thoracic wall and, 152
 —tongue and, 106, 544
 —vertebral column and, 413
 Actinomycotic ulcer, 35
 "Acute abdomen," pneumonia and, 184
 Acute infectious diseases, acute epididymitis and, 260
 —acute orchitis and, 260
 Adamantine epithelioma, 115
 Adductor muscles of thigh, 351, 352, 355, 374, 375, 380, 382
 Adenitis, . acute, inguinal region swelling caused by, 598
 —cervical, acute, 119
 —chronic, 125
 —salivary, acute, 120
 —chronic, 125
 —submental, acute, 122
 Adenocarcinoma, 42
 —uterine, 300
 Adenofibroma, description of, 38
 Adenoma, description of, 38
 —anal, 674
 —bladder, 231
 —face, 85
 —fetal, in thyroid gland, 139
 —kidney, 215
 —large intestine, 663
 —lip, 99
 —liver, 716
 —osteochondro-, neck, 142
 —ovarian, 290, 291
 —pancreatic, 699
 —parotid gland, 93
 —penial, 254
 —rectal, 674
 —simple, breast, 173
 —stomach, 622
 —small intestine, 637
 —testicle, 264
 —tongue, 107
 —uterine, 299
 Adenomatous cyst, thyroid gland, 139
 Adenomatous goiter, 138, 139
 Adenomyoma, 40
 —pelvic structures, 292
 —rectovaginal septum, 292
 —rectum, 292
 —round ligament, 292
 —sigmoid flexure, 292
 —uterosacral ligament, 292
 Adrenal gland, hypernephroma of, 215
 Adrenalin, Goetsch test, exophthalmic goiter and, 140
 Adynamic ileus. *See* Paralytic ileus.
 Age, etiologic factor in affections, 9, 10, 11
 Agraphia, 77
 Ainhum, form of gangrene, 32

- Albers-Schönberg disease, 395
 Albumosuria, 43. *See also* Bence-Jones protein.
 Alcohol, affections of bladder, prostate and seminal vesicles in relation to, 221
 — esophageal varix caused by, 203
 — kidney affections and, 208
 — use of, in chronic esophagitis, 200
 Alcoholic history, facts to be ascertained in, 4
 — gastro-enteric tract affections and, 3
 Amblyopia, lesions of corpora quadrigemina and, 78
 Amebæ, surgical affections caused by, 28
 Amebiasis, 24
 Amebic dysentery, 660
 Amenorrhea, cervical atresia and, 305
 — cervical stenosis and, 305
 — hematometra and, 301
 — inflammatory conditions of ovary associated with, 287
 — superinvolution of uterus, 303
Amœba dysentericæ, amebiasis caused by, 24
 Amputation neuroma, 40
 "Amputation" of arms, 333
 Anal abscess, 669
 Anal fissure, 669
 Anal fistula, 669
 Anatomic charts. *See* under charts.
 Anconeus, nerve supply of, 365, 368
 Anemia, achlorhydria in, 616
 — acute gastric ulcer in, 628
 — attended by symptoms of simple inflammation of uterus, 301
 — bladder tumors in, 231
 — splenic, 705
 — von Jaksch's, 707
 Anemia pseudoleukemica infantum, 707
 Anencephaly, 53, 68
 Anesthesia, anal, cauda equina paralysis and, 376
 — types of, in nerve injuries, 362
 — ulnar nerve region, Klumpke's paralysis and, 346
 Anesthetic form of leprosy, 23
 Aneurysm, 528
 — abdominal, 628 insert 1
 — aortic, 195, 708
 — arteriovenous, 49, 127, 529
 — axillary, 162, 364
 — bone, 396
 — brachial, 341
 — "brassy" cough in, 195
 — cerebral, 73
 — carotid, 127
 — common, 127
 — cirroid, 49, 85, 336, 530
 — expansile pulsation in, 127
 — hepatic, 718
 — humeral, 337
 — iliac, 665
 — in neck, 127
 — in thigh blood-vessels, 352
 — inferior-polioencephalitis associated with, 71
 — mediastinal, 195
 — post-traumatic, in thigh, 325
 — racemous, 530
 — radial, 343
 — renal, 212, 708
 — splenic, 703, 704, 708
 — swelling caused by, femoral region, 597
 Aneurysm, swelling caused by, inguinal region, 598
 — thoracic wall, 152
 — tracheal "tug," 195
 — trauma causing, 127, 529
 — true, 528
 — ulnar, 343
 — varicose, 529
 — vertebral, 127
 Aneurysm signs, alcoholic history and, 4
 Aneurysmal pulsation in thigh, 352
 Aneurysmal varix, 529
 Angina, Ludwig's, 121, 122
 — Vincent's, 102, 121
 Angioma, bladder, 231
 — brain, 79
 — breast, 173
 — cavernous, of arm, 335, 342
 — esophageal, 204
 — hand and fingers, 347
 — kidney, 215
 — large intestine, 663
 — lip, 99
 — liver, 716
 — lung, 187
 — mouth, 103
 — muscle, 546
 — parotid gland, 93
 — peritoneal, 606
 — rectal and anal, 675
 — shoulder, 329
 — thigh muscles, 352
 — tongue, 107
 — umbilical, 583
 — uterine, 299
 — vulval, 310
 Anilin, bladder affection and, 221
 Ankle, dislocations of, 502
 — fractures of, 502
 Ankle joint, congenital malformations of, 357
 — diseases of, 424
 — injuries to, 358
 — sprains of, 358
 — talipes calcaneus of, 357
 — talipes equinus of, 357
 — talipes equinovarus of, 357
 — talipes valgus of, 357
 — talipes varus of, 357
 — tuberculosis of, 430
 Anthrax, 16
 — death from, 340
 — elbow and, 340
 — face and, 84
 — gastric, 16
 — hand and, 347
 — intestinal, 16
 — lip and, 99
 — lung and, 184
 — relation of occupation to, 84
 Anthrax bacillus, surgical affections caused by, 27
 Anuria, relation to kidney affections, 208
 — ureteral calculus and, 217
 Anus, absence of, 305
 — actinomycosis of, 670
 — anesthesia of, cauda equina paralysis and, 376
 — condylomata of, 674
 — irritation of, simple vulvitis and, 310
 — pruritus of, 672
 — rectum and, 665

- Aorta, abdominal rupture of, 576
 —aneurysm of, 195
 —thoracic, aneurysm of, 708
 Ape hand, 334
 Aphasia, cerebral vascular spasm and, 74
 Aphonia, vagus nerve affections and, 66
 Apoplectiform seizures, 74
 Apoplexy, ovarian, 287
 —See also Cerebral hemorrhage.
 Appendicitis, acute, differential diagnosis in, 644-646
 — retrocecal, *facing* 721
 — in children, 642
 Appendix, actinomycosis of, 647
 —affections of, examination in, 640, 641, 642
 — history of, 640
 — interpretation of, 641
 — cysts of, 647
 —inflammations of, 628 insert 2, 642, 646, 648, 654, 722
 —tuberculosis of, 647
 —tumors of, 647, 650
 Arborescens, lipoma, of joints, 436
 Area, Broca's, 77
 —motor, brain, 76
 —of dulness, paravertebral, mediastinal abscess and, 194
 —retrosternal, mediastinal abscess and, 194
 —sensory, brain, 76
 Arm, circulatory disturbances of, 336
 —congenital malformations, 333
 —edema of, 163, 169
 —inflammations of, 335
 —injuries of, 333, 334
 —neuritis of, 336
 —tumors of, 334, 335, 336, 338, 339
 Arteries, affections of, Chap. XIII, 527
 —aneurysm of, 528
 —arteriosclerosis of, 530
 —embolism of, 530
 —inflammations of, 528
 —injuries of, 527
 —thrombo-angiitis obliterans of, 528
 —thrombosis of, 531
 Artery, anterior tibial, injury to, 355
 —brachial, injuries of, 334
 —carotid, internal, injury of, 62
 —hemorrhage from, middle meningeal, differential chart of, 58-61
 —peroneal, injury to, 355
 —renal, aneurysm of, vertebral erosion in, 213
 —vertebral, injury of, 62
 Arthralgia, 424, 425
 Arthritis, 425
 —acute, differential chart of, 435-437
 —of infants, 427
 —atrophic, 431, 432
 —gonococcus infection complicated by, 20
 —hypertrophic, 431
 —Heberden's nodes in, 431, 432
 —neuropathic, 433
 —sternoclavicular joint and, 332
 —osteo-, acute, 410
 — differential chart of, 434, 436
 —pneumococcic, 428
 —primary, acute, 425
 —secondary to acute infectious disease, 427, 428
 —Still's disease and, 431
 Arthritis, traumatic, 427
 —tuberculous, chronic, 428
 —typhoid, 428
 —shoulder joint and, 332
 —villous, knee joint and, 353
 Arthritis deformans, 431
 —shoulder joint and, 333
 Ascites, abdominal enlargement caused by, differential chart of, 604
 —etiologic chart of, 609
 —examination for, 555
 —gastric carcinoma and, 629
 —liver cirrhosis and, 717
 —tympany in, 604
 Ashhurst classification of bone cysts, 397
 Ashton, on vaginismus, 312
 Aspergillus, pulmonary affections and, 191
 Asphyxia, acute erysipelatos stomatitis causing, 102
 —traumatic, 148
 —tumors of esophagus and, 204
 Aspiration, chylothorax and, 187
 —malignant tumor of lungs and pleuræ and, 191
 —pericarditis with effusion and, 178
 —pleural cavity in empyema and, 183
 Astragalus, fractures of, 503
 Ataxia, cerebellar, 79
 —acute encephalitis and, 70
 —hydrocephalus and, 70
 —lesions of corpora quadrigemina and, 78
 —lesions of medulla and, 79
 —lesions of pons and, 79
 Atlas, dislocation of, on axis, 507
 Atresia of cervix, 305
 Auditory nerve, injury of, 66
 —deafness from, 66
 —frequency of, 66
 —injury of facial nerve associated with, 66
 Auscultation, abdominal, facts ascertained by, 7
 —vertigo from, 66
 —thoracic, facts ascertained by, 7
 Auscultatory percussion, 6
 —stomach and, 6
 Aviles, on gall-bladder tænia, 721
 Avulsion. See Skin.
 Axilla, actinomycosis of, 161
 —affections of, 157
 — differential chart of, 160, 161
 — history of, 158
 — interpretation of, 158
 — regional chart of, 157
 —aneurysm of, 162
 —carcinoma of, secondary to carcinoma of breast, 163
 —hematoma of, 158
 —Hodgkin's disease of, 162
 —inflammatory conditions of, 159, 160, 329
 —injury to, brachial plexus paralysis caused by, 364
 —lymphadenitis in, tuberculous, 159, 160
 —lymphatic leukemia in, 162
 —syphilis of, 160
 —traumatic conditions of, 158
 —tumors of, 162, 163
 Bacillary dysentery, 660
Bacillus aerogenes capsulatus, 27
 —emphysematous gangrene caused by, 356

- Bacillus aërogenes capsulatus*, see also *Bacillus welchii*.
- Bacillus anthracis*, anthrax caused by, 84
- Bacillus coli*, as factor in septicemia, 15
- surgical affections caused by, 27
- Bacillus diphtheriæ*, surgical affections caused by, 27
- Bacillus Ducey*, chancreoid caused by, 250
- surgical affections caused by, 27
- Bacillus dysentericæ*, affections caused by, 27
- Bacillus influenzae*, surgical affections caused by, 26
- Bacillus lepræ*, affections caused by, 27
- leprosy caused by, 23
- Bacillus mallet*, glanders caused by, 24
- surgical affections caused by, 27
- Bacillus œdematis*, infection from, 20
- Bacillus of Boas-Oppler*, stomach carcinoma and, 629
- Bacillus pestis*, affections caused by, 28
- Bacillus pyocyaneus*, surgical affections caused by, 27
- Bacillus welchii*, surgical affections caused by, 27
- Back, deformity of, chronic osteo-arthritis of vertebral column and, 409
- injury of, sciatica caused by, 352
- pain in, chronic prostatitis and, 236
- etiologic chart of affections causing, 271, 272
- flat feet and, 358
- history of, 272, 273
- laceration of cervix and, 304
- uterine prolapse and, 298
- Bacteriemia, 15
- Bailey's test for shoulder injury, 512
- Baker's cysts, 436
- Balanitis, 249
- Ballance's sign, 574
- Banti's disease, 705
- differential diagnosis of, 708
- Krumphaar on, 705
- Moynihan on, 705
- urine in, 710
- Barlow's disease of bone, 393
- Bartholin's gland, infection of, 20
- vulvitis and, 310
- Basal-cell carcinoma, 42
- of face, 90
- Basal ganglia, 78
- tumors of, 80
- Baseball finger, 490
- Basedow's disease, 139. *See also* Exophthalmic goiter.
- Bayonet leg, 501
- Bed-sores, 32
- Bell's sign, facial nerve affections and, 66
- Bence-Jones protein, myeloma and, 43
- Benedict, E. B., on gall-bladder tænia, 721
- Bennett's fracture, 488
- Biceps, leg, nerve supply of, 375
- paralysis of, 380
- subcutaneous rupture of, 325, 326, 334
- Biceps femoris muscle, tibial nerve paralysis and, 378
- Bilharzia affecting kidney, 215
- Bile pigments in blood, 741
- Van den Bergh test of, 741
- Biliary ducts, affections of, Chap. XXIII, 726
- regional chart of, 726
- calculi in, 728
- Biliary ducts, carcinoma of, jaundice in, 730
- congenital anomalies in, 726
- foreign bodies in, 727
- inflammations of, 726
- acute catarrhal jaundice in, 726
- acute suppurative cholangitis in, 727
- acute ulcerative cholangitis in, 727
- chronic catarrhal jaundice in, 727
- chronic cholangitis in, 727
- injuries in, 726
- obstruction of, 728, 729
- common bile-duct, 621, 728
- hepatic duct, 729
- parasites in, 728
- strictures of, 729
- tumors of, 730
- carcinoma, 730
- Birth-mark, 155. *See also* Hemangioma.
- Birth-palsy of Erb, 423
- "Black Death of London," 20
- Bladder, affections of, sexual excess and, 221
- sexual hyperchondriasis and, 224
- spinal cord affections causing, 222
- stricture and, 221
- syphilis and, 221
- urinary symptoms in, 223
- atony of, 226
- postoperative, 226
- calculi of, 227, 228
- change of posture affecting symptoms in, 228
- cystoscopic examination of, 228
- rectal palpation in, 228
- sounding in, 228
- urine in, 228
- vaginal palpation in, 228
- congenital absence of, 226
- congenital anomalies of, 225
- diverticulum of, 226
- double, 226
- exstrophy of, 225
- fistulæ of. *See* Vesical fistulæ.
- foreign bodies in, 228
- cystoscopic examination of, 228
- sounding of, 228
- granulomata of, 229
- hernia of, 228
- difficulty in urination in, 228
- history of, 220
- interpretation of, 220
- inflammatory conditions of, 230
- acute cystitis in, 230
- chronic cystitis in, 230
- injury to, 575
- abdominal wall, 574
- pelvic fractures complicated by, 492
- irritability of, uterine myomata and, 299
- neuroses of, 234
- enuresis in, 234
- pain in, 224, 225
- papilloma of, malignant change in, 231
- persistent cloaca in, 226
- prostate and seminal vesicles and, affections of, regional chart of, 218
- rupture of, 227
- extraperitoneal, 227
- intraperitoneal, 227
- shock in, 227
- trigone of, common site of secondary involvement in kidney tuberculosis, 211

- Bladder, tuberculosis of, 229
 —cystitis with, 229
 —cystoscopic examination of, 229
 —gonorrheal cystitis with, 229
 —guinea-pig inoculation in, 229
 —urine in, 229
 —tumors of, 218, 230, 231
 —anemia in, 231
 —cystitis of, 230
 —histologically benign, death from, 230
 —ulcer of, simple, 229
 —aid of cystoscopic examination in differentiating from tuberculous ulcer, 229
 —umbilical fistula of, 226
 —varix of, 228
 Blastomycosis, as granulomatous infection, 23
 —breast and, 171
 —cervical lymph glands and, 133
 —face and, 82
 —lung and, 185
 —lymph glands in, 539
 —tongue and, 106
 —vertebral column and, 413
 Bleeding, after coitus, carcinoma of vagina and, 309
 —endometrial hypertrophy and, 303
 —malignant tumors of vulva and, 310
 —sarcoma and, uterine, 301
 —vaginal, 309
 —tumors of large intestine and, 666
 —uterine, 300
 —vaginal, tubal pregnancy and, 296
 "Bleeding kidney," 213
 Blindness, in association with optic nerve injury, 63
 Blood, acute appendicitis and, 648
 —acute gastro-enteritis and, 695
 —acute pancreatitis and, 695
 —acute peritonitis and, 697
 —acute salpingitis and, 653
 —Banti's disease and, 708
 —bile pigments in, 741
 —Van den Bergh test in, 741
 —bright red, in stools, gastro-enteric tract affections and, 3
 —carbon dioxid combining power in, 741
 —chemistry of, 740
 —Myers on, 741
 —chlorids in, 741
 —coagulation time in, 740
 —conditions of, splenomegaly and, 705
 —contents of carcinoma of breast and, 174
 —coronary thrombosis and, 695
 —creatinin of, 741
 —dark brown or tarry, gastro-enteric tract affections and, 3
 —differential count of, 739
 —erythrocytes in, 739
 —examination of, 8
 —breast affections and, 169
 —chloroma and, 156
 —kidney affections and, 208
 —extra-uterine pregnancy and, 653, 695
 —fresh, examinations of, 740
 —gall-bladder perforation and, 697
 —gastro-intestinal perforation and, 697
 —hemoglobin in, 739
 —hemorrhoids and, 671
 —Hodgkin's disease and, 132, 538
 —jaundice and, 736
 —Blood, Kahn precipitation test of, 740
 —leukocytes in, 738
 —surgical affections and, 738, 739
 —lymphatic leukemia and, 132
 —malignant tumors of rectum and, 675, 676
 —mesenteric tear and, 697
 —nitrogen in, non-protein, 741
 —omental torsion and, 649
 —ovarian cyst torsion and, 652
 —red cells in, 739
 —relation to surgical affections of, Chap. XXIV, 738
 —sugar in, 740
 —tuberculosis of rectum and, 670
 —typhoid ulcer and, 649
 —urea of, 741
 —vomiting of, in gastric carcinoma, 625
 —in liver cirrhosis, 625
 —Wassermann test of, 740
 —white cells in, 739
 —Widal reaction in, 740
 Blood culture, 740
 —acute osteomyelitis and, 388
 —pyemia and, 15
 —septicemia and, 15
 Blood groups, 740
 Blood-platelets, 740
 Blood-pressure, cerebral hemorrhage and, 72
 —exophthalmic goiter and, 140
 —head injury and, 52
 —hypernephroma and, 215
 —kidney affections and, 208
 —low, as factor in production of cerebral thrombosis, 73
 —upper extremities, aneurysm of aorta and, 195
 Blood-vessels, affections of, producing neurologic diseases, 72
 Boas-Oppler bacillus in stomach carcinoma, 629
 Bónes, abscess of, bone cysts as complication of, 397
 —Brodie's, 388
 —tuberculous, 389
 —acromegaly of, 394
 —actinomycosis of, 389
 —affections of, Chap. XI, 383
 —anatomic chart of, 383, 384
 —examination of, 385
 —history of, 385
 —references, 437, 438
 —vertebral column, 406
 —Albers-Schönberg disease of, 395
 —aneurysm of, 396
 —atrophy of, 386
 —Allison and Brooks on, 386
 —lesions of central nervous system caused by, 386
 —carcinoma of, 399
 —metastatic, 404
 —chondromata of, 399
 —differential chart of, 400, 401
 —contusions of, 385
 —cysts of, 384, 397
 —Ashhurst classification of, 397
 —bone abscess complicated by, 397
 —giant-cell sarcoma complicated by, 397
 —multiple chondromata complicated by, 397
 —myxoma complicated by, 397

- Bones, cysts of, osteitis deformans complicated by, 397
- osteitis fibrosa cystica complicated by, 397
- osteomalacia complicated by, 397
- subperiosteal hematoma complicated by, 397
- deformities of, osteitis deformans and, 397
- diseases of, 384
- acromegaly, 394
- Barlow's disease, 393
- rickets, 394
- dystrophies of, 384
- chondrodystrophia foetalis, 393
- osteodystrophia cystica, 393
- endothelioma of, Ewing's tumor, differential chart of, 402, 403
- enostoses of, 396
- epiphysitis of os calcis, 392
- exostoses of, 396, 399
- fibromata of, 399
- forearm, affections of, 343
- injuries to, 342
- fragilitas ossium, 395
- giant-cell tumors of, differential chart of, 400, 401
- granulomata of, 384, 389
- hand and finger, affections of, 348
- hyperostosis of, 396
- hypertrophy of, 386
- facial, 386
- tibial, 386
- idiopathic psathyrosis of, 395
- inflammation of, 383, 386, 387, 388
- acute infective periostitis, 387
- acute osteomyelitis, 387
- acute traumatic periostitis, 386
- chronic osteomyelitis, 388
- chronic periostitis, 388
- subacute osteomyelitis, 388
- inflammatory conditions of, 383, 386, 387, 388
- injuries of, 383
- Kohler's disease of, 391, 392
- long, early metastasis of, hypernephroma to, 215
- marble-, 395
- Marmorknochen, 395
- myeloma of, 384, 405
- multiple, differential chart of, 404, 405
- necrosis or caries of, 383, 389
- osteomyelitis causing, 389
- tumor causing, 389
- phosphorus causing, 389
- Osgood-Schlatter's disease of, 391, 392
- ossifying hematoma of, differential chart of, 400, 401
- osteitis fibrosa cystica, 398
- osteochondritis of, 384, 391
- osteochondritis deformans juvenilis, 391
- osteochondritis deformans juvenilis dorsi, 392
- osteochondritis dissecans of Konig, 391, 393
- osteochondritis syphilitica, 393
- osteogenesis imperfecta, 395
- osteogenic sarcoma of, differential chart of, 400, 401
- osteomalacia of, 395
- osteomata of, 399
- Bones, osteomyelitis of, in children, Mitchell's classification, 389
- osteopsathyrosis of, 395
- osteosclerosis fragilis generalisata, 395
- Perthes' disease of, 391
- rachitis of, 394
- riders', 345, 352, 355
- sarcoma of, 405
- scurvy of, infantile, 393
- syphilis of, 390
- congenital, 390
- craniotabes in, 391
- hot-cross bun of skull, 391
- osteoperiostitis in, 390
- Parrot's nodes in, 391
- secondary stage of, 391
- sinus in, 391
- tertiary stage of, 391
- tuberculosus of, 389, 390
- abscess in, 389
- sinus in, 390
- tumors of, 384, 399
- bone necrosis caused by, 389
- differential chart of, 400-405
- Kolodny (Codman) classification of, 404, 405
- vertebral epiphysitis of, 392
- wounds of, 385
- Bone-marrow conditions associated with splenomegaly, 705
- Bougies, perforation of uterus caused by, 298
- esophageal, in disease of esophagus, 128
- Brachial artery, aneurysm of, 341
- injuries of, 334
- Brachial plexus, paralysis of, 364
- anatomic chart of, 364
- aneurysm causing, axillary, 364
- subclavian, 364
- cervical rib causing, 364
- clavicle fracture causing, 364
- cord, outer, 364
- inner, 364
- posterior, 364
- etiology of, 364
- humerus fracture causing, 364
- injury to axilla causing, 364
- neuritis causing, 364
- post-fracture callus causing, 364
- scapula fracture causing, 364
- shoulder fracture causing, 364
- shoulder joint dislocation causing, 364
- symptoms of, 366
- trauma causing, 364
- Brachialis anticus muscle, nerve supply of, 365
- Brachioradialis muscle, nerve supply of, 365
- Brachydactylia, 345
- Brain, abscess of, 71
- acquired hernia and, 69
- actinomycosis and, 75
- affections of, circulatory, 71
- regional chart of, 67
- atrophy of, 70
- general paresis in, 70
- compression of, 57
- concussion of, 57
- contusion of, 62
- frontal lobe of, 77
- gumma of, 74, 79

- Brain, hemorrhage of, 72. *See also* Cerebral hemorrhage.
- hypertrophy of, 70
 - inflammatory affections of, 70
 - injuries of, 57
 - associated with petechiæ, 72
 - laceration of, 62
 - malformations of, 68
 - motor area of, 76
 - occipital lobe of, 78
 - parietal lobe of, 78
 - sensory area of, 76
 - “silent areas” of, 446
 - size of, mental capacity and, 70
 - smell center of, 77
 - solitary tubercle of, 79
 - speech centers of, 77
 - syphilis of, 74
 - taste center of, 77
 - temporal lobe of, 78
 - tuberculosis of, 75
 - hyperacute miliary, 75
 - solitary tubercle, 75
 - subacute meningitis, 75
 - tumors of, 79
 - choked disk in, 81
 - cranial nerve involvement in, 81
 - facial palsy in, 81
 - jacksonian epilepsy in, 81
 - progression in symptomatic, 81
 - symptoms of, 80, 81
 - vision center of, 77
 - wet, uremic and alcoholic subjects and, 72
 - writing center of, 77
- Branchial cleft, cysts of, 128
- fistula of, 126
 - symptom-complex of, 126
- Branchiogenic carcinoma, 133
- Breast, actinomycosis of, 171
- multiple sinuses in, 171
 - affections of, dimpling of skin in, 168
 - edema in, arm, 169
 - hand, 169
 - examination of blood in, 169
 - marital history in, 165
 - menstrual history in, 165
 - nipple in, 168
 - pain in, 166
 - pregnancy in relation to, 166
 - regional chart of, 163
 - blastomycosis of, 171
 - “blood contents” in carcinoma of, 174
 - congestion of, 169
 - cysts of, 172
 - dermoid, 172
 - echinococcus, 172
 - fibro-, adenoma of, 173
 - galactoceles, 172
 - lymphatic, 172
 - retention, 172
 - sebaceous, 172
 - general cystic disease of, 172
 - granulomata of, 171
 - gumma of, 171
 - history of, interpretation of, 165
 - hypertrophy of, 172
 - inflammation of, acute deep, 169
 - acute mastitis in, 169
 - acute parenchymatous, 169
 - acute subcutaneous, 169
- Breast, inflammation of, acute superficial, 169
- inflammatory conditions of, 169
 - abscess in, 169
 - chronic, 169
 - differential diagnosis of, 170
 - retromammary abscess in, 169
 - injury of, 146
 - malignant conditions of, cough, 166
 - dyspnea accompanying, 166
 - nipple of, diseases of, 176
 - Paget's disease of, 176
 - papillary cystadenoma, 173
 - surgical affections of, history of, 164
 - syphilis of, 171
 - tuberculosis of, 171
 - confluent, 171
 - discrete, 171
 - tumors of, 173, 174
 - adenoma, 173
 - angioma, 173
 - carcinoma, 174, 175
 - chondroma, 173
 - classification of malignant, clinical, 174
 - pathologic, carcinoma in, 174
 - differential chart (clinical) of conditions causing, 176, 177
 - endothelioma of, 174
 - injury in relation to, 146
 - lipoma, 173
 - myxoma, 173
 - periductal fibroma, 173
 - periductal myxoma, 173
 - periductal sarcoma, 173
 - sarcoma, 175
- Breath, putrid, gangrene of lung and, 184
- Breathing, bronchial, empyema and, 183
- difficulty in, Ludwig's angina and, 121
 - thyroid affections and, 135
- Broad ligaments, affections of, 293
- carcinoma of, 293
 - cysts of, 293
 - dysmenorrhea caused by, 293
 - edema of legs caused by, 293
 - hemorrhoids caused by, 293
 - menorrhagia caused by, 293
 - metrorrhagia caused by, 293
 - fibroma of, 293
 - lipoma of, 293
 - parovarian varicocele, 293
 - sarcoma of, 293
 - tumors of, 293
- Broca's area, 77
- Brodie's abscess, 388
- Bronchi, injury of, 148
- Bronchiectasis, 184
- Dittrich's plugs in, 184
 - diverticulum of bronchus in, 184
 - pulmonary abscess and, 182
 - sputum in, 184
- Bronchus, diverticulum of, bronchiectasis and, 184
- Brown and Sampson, on tuberculosis of large intestine, 662
- Bryant's triangle, Fig. 21, 493; 495
- Bubo, inguinal, chancroid complicated by, 22
- Bubonic form of plague, 20
- Buhl's disease. *See* Icterus neonatorum.
- Bunion, 359
- Bursæ, affections of, Chap. XIII, 549

Bursæ, granulomata of, tuberculosis, 551
 —inflammatory conditions of, 550
 —injuries of, 549
 —knee, 354
 —diseases of, 354
 —olecranon, inflammation of, acute, 336
 —chronic, 336
 —tuberculosis of, 336
 —overlying joint of big toe, inflammation of, 359
 —prepatellar, tuberculosis of, 354
 —shoulder, affections of, 327
 —clavicular, chronic inflammation of, 328
 —subdeltoid, tuberculosis of, 328
 —subacromial, arthritic deposits in, 327
 —hematoma of, 327
 —inflammation of, 327
 —subdeltoid, arthritic deposits in, 328
 —hematoma of, 328
 —inflammation of, 327
 —thyroid, 129, 142
 Bursitis, achillo-, 360
 —acute, 550
 —calcaneo-, 360
 —chronic, 550
 —prepatellar, 354
 —pretibial, 354
 —suprapatellar, 354
 "Butterfly" appearance, goiter and, 137
 —lupus and, 83
 "Butterfly" shape, congenital hypertrophy of thyroid with, 135

Caked breast, 167
 Calcaneobursitis, 360
 Calculi, bladder, 227, 228
 —biliary duct, 728
 —common bile-duct, 621
 —gall-bladder, 720
 —hepatic duct, 729
 —kidney, 213, 214, *facing* 721, 724
 —pancreatic, 698
 —parotid gland, 97
 —passing of, in relation to genito-urinary tract affections, 37
 —penial, 251
 —prostatic, 236
 —renal, *facing* 721. *See also* Calculi, kidney.
 —salivary, acute submental adenitis caused by, 122
 —etiologic factor in chronic diffuse inflammation of parotid gland, 92.
 —Stenson's duct, 97
 —ureteral, 217, 652
 —urethral, 257
 Calipers, use of, in fractures, 442
 Callaway's test for shoulder injury, 512
 Calzavara, on pancreas inflammations, 711
 Cammidge reaction, pancreas and, carcinoma in, 700
 —pancreatitis and, chronic, 698
 Cancer. *See* Carcinoma.
 "Cancer en cuirasse," 156
 Capitellum, fractures of, 477
 Caput medusæ, 717
 Carbolic acid, gangrene caused by, 32
 Carbon dioxid combining power of blood, 741
 Carbuncle, 14
 —abdominal wall, 578

Carbuncle, arm, 335, 340
 —axilla, 329
 —diabetes and, 120
 —elbow, soft tissues of, 340
 —face, 82
 —hand, 347
 —neck, 120
 —scalp, 48
 —thigh, 351
 Carcinoma, 41
 —abdominal wall, 581
 —adeno-, 42
 —appendix, 647
 —axillary, edema of arm and, 163
 —secondary to carcinoma of breast, 163
 —basal cell, 42
 —of face, 90
 —bile-duct, jaundice in, 730
 —bladder, 231
 —body of uterus, 300
 —bone, 399
 —metastatic, 404
 —brain, 79
 —branchiogenic, 133
 —breast, "blood contents" in, 174
 —pathologic classification of, 174
 —broad ligament, 293
 —cecal, 657
 —cervical lymph gland, 133
 —colloid, 42
 —cubital lymph gland, 337
 —esophageal, 201, 204
 —face, 90
 —fallopian tube, 296
 —finger, 347
 —forearm, soft tissues of, 343
 —gall-bladder, 722, 723, 720
 —gastric, 622-630
 —hand, 347
 —humerus and, spontaneous fracture of, 338
 —large intestine, 663, 666
 —jaw, 113
 —kidney, 215
 —liver, 716
 —lung, 187
 —metastatic lymph glands in, 539
 —mouth, 103
 —neck, 133, 142
 —branchiogenic, 133
 —epithelioma, 133
 —ovarian ligament, 293
 —pancreatic, 699
 —papillary, ureteral, 218
 —parotid gland, 96
 —penial, 255
 —prostatic, 238
 —rectum and anus, 675
 —round ligament, 294
 —scirrhus, 42
 —secondary involvement of cervical lymph glands, 133
 —shoulder, 330
 —sigmoid, 665
 —skull, 55
 —small intestine, 637
 —spleen, 710
 —stomach, 622-630
 —testicle, 264
 —thoracic wall, 156

- Carcinoma, thyroid, developing in preëxisting
goiters, 143
—tongue, 107
—tumors of peritoneum and, 606
—umbilical, 584
—upper arm, 335
—urethral, 257
—uterine, 299, 300
—vaginal, 309
—vertebral column, 417
—vulval, 310
Carcinosis, ossifying, von Recklinghausen's,
accompanying prostatic carcinoma,
238
Cardia, stomach, carcinoma of, 629
Cardiac difficulties, signs of, in relation to
alcoholic history, 4
Cardiac disease, chronic passive congestion
of kidney and, 212
Cardiospasm, 614
—esophageal bougies used in, 614
—esophageal dilatation caused by, 202
Caries of bone, 389
Carotid artery, common, aneurysm of, 127
—external, aneurysm of, 127
—internal, aneurysm of, 127
Carotid body, tumors of, 134
Carpal bones, dislocations of, 578
—os magnum, 519
—scaphoid, 519
—semilunar, 518
Carpometacarpal joints, dislocations of, 519
—examination in, 519
Carpus, dislocation of, backward, Fig. 32, 519
—fractures of, 487
Cartilage. *See* Joints, affections of.
Caruncle, ureteral, 218
—urethral, 257
Case history taking, general, 1
Cauda equina, paralysis of, 376
—lesion below third lumbar root, 376
—lesion below second sacral root, 376
—lesion below third sacral root, 376
—sensory nerve supply of, 376
—anatomic chart of, 376
Caudate nucleus, involvement of, elevation of
temperature with, 78
Cavernitis, chronic, 250
Cavernous angioma, arm, 335, 342
—forearm, 342
Cavernous sinus, injury of, 62
—thrombosis of, 63
Cecum, actinomycosis of, 657, 661
—obstruction of, chronic, 685
—tuberculosis of, 654
—tumors of, 657
Cellulitis, 14
—abdominal wall, 578, 579
—axilla, 159
—elbow region, 340
—face, 82
—neck, 119
—penial, 250
—scalp, 48
—thigh, 351
—thoracic wall, 151
—upper arm, 335
Center, brain, smell, 77
—speech, 77
—taste, 77
Center, brain, vision, 77
—writing, 77
Central nervous system, lesions of, bone atro-
phy caused by, 386
Cephalhematoma, 47
Cerebellar ataxia, 79
—acute encephalitis and, 70
—hydrocephalus and, 70
Cerebellar tumors, 79
Cerebellum, lesions of, 79
Cerebral abscess, apoplecticiform seizures in, 74
—skull fracture complicated by, 447
Cerebral aneurysm, 73
Cerebral compression, skull fractures and,
446
Cerebral concussion, skull fractures and, 446
Cerebral contusion, skull fractures and, 446
Cerebral cortex, tumors of, 80
Cerebral edema, skull fractures and, 446
Cerebral embolism, 73
Cerebral hemorrhage, 72, 73
Cerebral laceration, skull fractures and, 446
Cerebral localization, 76
Cerebral palsy of childhood, 69
Cerebral spasm, 73
Cerebral symptoms, exophthalmic goiter and,
140
Cerebral thrombosis, 73
Cerebrospinal fever, joints in, 428
Cerebrum, hernia of, 592
Cervical adenitis, acute, 119
Cervical lymph glands, actinomycosis of, 133
—affections of, 130
—blastomycosis of, 133
—carcinoma of, 133
—secondary involvement of, 133
—Hodgkin's disease of, 132
—hyperplasia of, 130
—lymphatic leukemia of, 132
—lymphoblastoma of, 133
—malignant lymphoma of, 133
—sarcoma of, 133
—syphilis of, 132
—von Mikulicz's disease of, 133
Cervical spine, fractures of, 455
Cervix, atresia of, 305
—carcinoma of, 300
—chancre of, 305
—hypertrophy of, 304
—intracervical mucosa, eversion of, 305
—lacerations of, 303, 304
—polypi of, 304
—stenosis of, 305
—transillumination of, L. R. Thompson on,
304
Chancre, 21
—cervical, 305
—finger, 348
—intra-urethral, 257
—lip, 84
—penial, 252
—soft. *See* Chancroid.
—*Spirochæta pallidum* causing, 252
—vulval, 310
Chancroid, 22, 250
—*B. Ducrey* causing, 250
Chancroidal ulcer of rectum, 673
Charcot's disease, elbow joint, 339
—hip joint, 350
—*See also* Neuropathic arthritis.

- Charcot's disease, shoulder, 332
 Charcot's intermittent hepatic fever, 728
 Charcot's joint, 430, 433
 Chart, infections, 13
 —microorganisms, conditions caused by, 25-29
 Charts, anatomic. *See* Contents.
 —differential. *See* Contents.
 —regional. *See* Contents.
 Chauffard-Minkowski's disease, 706
 Chauffeur's fracture, 484
 Chemical inflammation, acute, of scrotum, 262
 Chemicals, cause of gangrene, 32
 Chemistry, blood, 740
 —Myers on, 741
 Chest. *See* Thorax.
 Chilblains, pains in, 360
 —ulcers following, 360
 Children, appendicitis in, acute, 642
 —diarrhea in, infectious, 660
 —pyelitis in, 211
 —tumors in, malignant ovarian, 290
 Chills, abscess and, kidney, 210
 —splenic, 702
 —acute inflammatory condition and, epidi-
 didymis in, 261
 —testicle in, 261
 —cholangitis and, acute suppurative, 727
 —cholecystitis and, acute purulent, 719
 —common bile-duct obstruction and, 728
 —gastritis and, phlegmonous, 615
 —genito-urinary tract affections and, 3
 —Hodgkin's disease and, acute, 162
 —jaundice and, 733
 —kidney affections and, 208
 —osteomyelitis and, acute, 388
 —peritonitis and, acute infective, 387
 —pyelitis, 211
 —pyelphlebitis, 714
 —pyonephrosis in, 210
 —Raynaud's disease and, acute stage of, 346
 —respiratory tract affections and, 3
 —urinary extravasation with infection and, 261
 —uterine rupture and, 298
 Chimney sweep's cancer, of scrotum, 264
 Chipault's method of relating body segments to vertebrae, 459
 Chlorids in blood, 741
 Chloroma, 42
 —blood examination in, 156
 —hemorrhagic diathesis in, 156
 —skull, 56
 —thoracic wall, 156
 Chocolate cyst of ovary, 291
 Choked disk, brain tumor and, 80
 —cavernous sinus thrombosis and, 63
 —cerebral aneurysm and, 73
 —compression of brain and, 62
 —hydrocephalus and, 70
 —venous sinus thrombosis and, 74
 Cholangitis, acute suppurative, 727
 —acute ulcerative, 727
 —chronic, 727
 Cholecystitis, acute, 628, 719, *facing* 721
 —acute catarrhal, 719
 —acute purulent, 719
 —chronic, *facing* 628, 719, 722
 Cholecystitis, chronic catarrhal, Judd on, 719
 —chronic purulent, 720
 —gall-stones in, 720
 —empyema, 720
 —purulent, 719, 720
 Cholelithiasis, *facing* 628, 720, *facing* 721
 Cholesteatoma, brain, 79
 Chondrodystrophia fetalis, 393
 —vertebral column in, 416
 Chondroma, 399
 —breast, 173
 —colloid, scapula and, 331
 —cystic, scapula and, 331
 —description of, 38
 —differential chart of, 400, 401
 —hand and finger, 347
 —humerus, 338
 —jaw, 111
 —lung, 187
 —multiple bone cysts as complication of, 397
 —parotid gland, 93
 —penial, 254
 —peritoneal, 606
 —phalanges, 348
 —rectum and anus, 675
 —scapular, 331
 —shoulder, 330
 —skull, 55
 —thoracic wall, 156
 —tongue, 107
 Chondrosarcoma, scapular, 331
 —shoulder, 330
 Chorio-epithelioma, hydatidiform mole caus-
 ing, 301
 —uterine, 299
 —metastasis of, to liver, 301
 —to lungs, 301
 —pregnancy with, 301
 —prognosis in, 301
 —symptoms of, 301
 Church, C. K., on ureteral stricture, 217, 273
 Chyle, escape of, thoracic duct injury and, 196
 Chylothorax, 186
 —aspiration in, 187
 —rupture of thoracic duct and, 186
 Circumflex nerve, 365
 —paralysis of, 366
 Cirrhosis, liver, 625, 627, 629, 717
 —esophageal varix and, 203
 —signs of, alcoholic history and, 4
 Cirroid aneurysm, 85, 530
 Claudication, intermittent, 360
 Clavicle, congenital malformations of, 324
 —dislocation of, 147, 510, 511; Fig. 30, 513
 —fractures of, 147, 459, 460, 461, 462; Fig. 5, 460; Fig. 6, 460; Fig. 7, 461
 —brachial plexus paralysis causing, 364
 —non-development of, accompanying imper-
 fect development of skull, 324
 "Claw-hand," 335, 372
 Cleft, branchial, 126, 128
 Cleft-palate, 101
 Cloaca, persistent, 226
 —malformations of vagina and, 305
 Club-foot, 357
 —following nerve lesion, 359
 Club-hand, 343
 Coagulation time of blood, 740

- Coccyx, dislocations of, 508
 —fracture of, 457, 492
 Codman (Kolodny) classification of bone tumors, 404, 405
 Colitis, chronic, 659, 664, 708
 —mucous, 660
 —ulcerative, 660
 Colles' fracture, 485, 486; Fig. 17, 485; Fig. 18, 486
 —"silver fork" deformity, 486
 Colon, obstruction of, chronic, 686
 —See also Intestine, large.
 Column, vertebral, affections of, 406
 Comedo of face, 85
 Comma bacillus of Koch, cause of cholera asiatica, 28
 Comminuted fractures, 439
 Common bile-duct, calculus of, 621
 —obstruction of, 728
 Compound fractures, 440
 Compression of brain, 57, 58-61, 62, 446
 Concussion of brain, 57, 58-61, 446
 Condylomata, anal, 674
 —penial, 254
 Condylomata acuminata, 674
 Congenital absence, of bladder, 226
 —of one kidney, 209
 Congenital anomalies, of ankle joint, 357
 —of biliary ducts, 726
 —of bladder, 225
 —of elbow joint, congenital dislocation, 338
 ——cubital valgus, 338
 ——cubital varus, 338
 ——dislocation of radius, 338
 ——dislocation of ulna, 338
 ——phocomelus, 338
 —of foot and toes, 358
 —of forearm, 341
 ——absence of radius, 341
 ——absence of ulna, 341
 ——hypertrophy, 341
 ——rudimentary formation, 341
 —of hip joint, 349
 —of intestines, cause of acute intestinal obstruction, 684
 —of joints, 418, 423
 —of kidney, 209
 —of knee joint, 352
 —of large intestines, 659
 —of leg, 355
 —of mouth, 101
 —of omentum, 610
 —of ovary, 286
 —of penis, 248
 —of rectum and anus, 668
 —of shoulder, 324
 —of stomach, 614
 —of thigh, 350
 —of tongue, 105
 —of upper arm, abrachia, 333
 ——monobrachia, 333
 ——perobrachia, 333
 ——"spontaneous amputation," 333
 —of ureter, 216
 —of vertebral column, 406
 ——absence of vertebræ, 409
 ——supernumerary vertebræ, 409
 ——transverse process, rudimentary, 409
 ——vertebral bodies, 409
 Congenital cyst, liver, 716
 Congenital cyst, umbilicus, 583
 Congenital dislocations, 506
 —elbow joint, 338
 —hip, Trendelenburg's sign and, 422
 —joint, 422
 —knee, 422
 —shoulder, 324
 Congenital displacement of kidney, 209
 Congenital diverticulum of esophagus, 202
 Congenital fistulæ of neck, 126
 Congenital hydrocele, 262
 Congenital hydrocephalus, 69
 Congenital hypertrophy of thyroid gland, 135
 Congenital inguinal hernia, 587
 Congenital myositis ossificans, 545
 Congenital phimosis, 248
 Congenital pronation of forearm, 341
 Congenital pyloric stenosis, 614
 ——tumor in, mass in, 614
 ——vomiting in, projectile, 614
 Congenital stenosis of cervix, 305
 Congenital strictures of esophagus, 201
 Congenital syphilis, 22
 ——bone, 390
 Congenital transposition of stomach, 614
 Congenital umbilical hernia, 589
 Conjunctival ecchymosis, in traumatic asphyxia, 148
 Constipation, gastro-enteric tract affections and, 3
 —genito-urinary tract affections and, 3
 —intestinal obstruction and, acute, 678
 ——chronic, 684
 —intussusception and, 683
 —rectocele and, 307
 —uterine prolapse and, 298
 Contractions, congenital, of fingers, 345
 Contracture, Dupuytren's, 345
 —elbow, soft tissues of, 340
 —Volkmann's ischemic, 346, 478
 —wrist, 344
 Contrecoup, in fractures, 439
 Contusion, abdominal wall, 571
 —bladder, 575
 —bone, 385
 —brain, 62
 ——differential chart of, 58-61
 —cerebral, skull fractures and, 446
 —diaphragm, 576
 —elbow joint, 338
 —forearm, 341
 —kidney, 574
 —leg, 355
 —muscle, 542
 —tendons, 547
 —thoracic wall, 146
 —upper arm, 334
 —urethral, 255
 Convulsions, head injury and, 50, 52
 —hydrocephalus and, 70
 Coprostasis, acute intestinal obstruction and, 678
 Coraco-acromial ligament, rupture of, 326
 Coracobrachialis muscle, nerve supply of, facing 365
 —rupture of, 325, 334
 Coracoclavicular ligament, rupture of, 326
 Cornea, ulceration of, facial nerve affections and, 66
 ——trigeminal nerve injury and, 65

- Corns, painful, in flat-foot, 358
 Coronary thrombosis, 694, 695
 Coronoid process, elbow and, fractures of, 481, 482
 Corpora quadrigemina, 78, 80
 Cortex, cerebral, tumors of, 80
 Costal cartilages, fractures of, 463
 Costovertebral rigidity, kidney affections and, 208
 Costovertebral tenderness, kidney affections and, 208
 Cotte, M. G., on tubal pregnancy, 296
 Cough, "brassy," aneurysm and, 195
 — bronchiectasis and, 184
 — empyema and, 183
 — esophageal injury and, 200
 — inflammatory mediastinal affections and, 194
 — lung injury and, 147
 — malignant condition of breast and, 166
 — malignant tumors of lungs and pleuræ and, 190
 — mediastinal affections and, 193
 — phlegmonous esophagitis and, 200
 — pleurisy and, 184
 — respiratory tract affections and, 3
 — sarcoma of thoracic wall and, 157
 Courvoisier's law, 729
 Coxa valga, 349
 Coxa vara, 349
 Cranial nerves, affections of medulla and, 79
 — affections of pons and, 79
 — brain tumors and, 81
 — cerebellar affections and, 79
 — cerebral aneurysm and, 73
 — eighth. *See* Auditory nerve.
 — eleventh. *See* Spinal accessory nerve.
 — first. *See* Olfactory nerve.
 — fourth. *See* Trochlear nerve.
 — head injury and, 52
 — inferior poliiencephalitis and, 71
 — injuries of, 63
 — — abducens, 65
 — — auditory, 66
 — — facial, 65
 — — glossopharyngeal, 66
 — — hypoglossal, 66
 — — oculomotor, 63
 — — olfactory, 63
 — — optic, 63
 — — spinal accessory, 66
 — — trigeminal, 64
 — — trochlear, 64
 — — vagus, 66
 — involvement of cavernous sinus thrombosis and, 63
 — — syphilis and, 74
 — manifestations in skull fractures, 445
 — ninth. *See* Glossopharyngeal nerve.
 — palsies of hydrocephalus and, 70
 — second. *See* Optic nerve.
 — seventh. *See* Facial nerve.
 — tenth. *See* Vagus nerve.
 — third. *See* Oculomotor nerve.
 — twelfth. *See* Hypoglossal nerve.
 Cranial sinus thrombosis, differential chart of, 64-65
 Craniocleidodysostosis, 324
 Craniotabes, bone syphilis and, 391
 — rickets and, 394
 Creatinin of blood, 741
 Crepitus, soft, epiphyseal separations and, 487
 Cretinism, 351
 — thyroid gland in, 143
 Crisis, Dietl's, 213, 214, *facing* 721
 Crotti, on woody thyroiditis, 136
 Crural nerve, anterior, 374
 — — paralysis of, 381
 — — muscles involved in, anatomic chart of, 382
 Cubital lymph glands, actinomycosis of, 337
 — carcinoma of, 337
 — Hodgkin's disease of, 336
 — hyperplasia of, 336
 — inflammation of, acute, 336
 — — chronic, 336
 — lymphatic leukemia of, 336
 — lymphosarcoma of, 337
 — syphilis of, 337
 — tuberculosis of, 337
 Cubitus valgus, elbow joint, 338
 — fractures of humerus and, 478
 Cubitus varus, elbow joint, 338
 — fractures of humerus and, 478
 Cuneiform, fractures of, 504
 Curets, perforation of uterus caused by, 298
 Curvature, penial, 251
 — vertebral column, 406, 413-416
 Cyanosis, esophageal injury and, 200, 203
 — finger, Raynaud's disease and, 346
 — foreign bodies of esophagus and, 200
 — pericarditis with effusion and, 178
 — retrosternal goiter and, 137
 — sternal fractures and, 147
 — thymus gland involvement and, 193
 — thyroid affections and, 135
 — traumatic asphyxia and, 148
 Cyclopia, 69
 Cystadenoma, 38
 — fibro-, breast, 173
 — papillary, breast, 173
 — pseudomucinous, ovarian, 291
 Cystic chondroma, scapular, 331
 Cystic dilatation of Stenson's duct, 98
 Cystic disease, breast, 172
 Cystic goiter, 138
 Cystic hemangioma, face, 85
 — neck, 129
 Cystic lymphangioma, face, 85
 — neck, 129
 Cystica fibrosa, osteitis, bone cysts as complication of, 397
 — kyphosis in, 398
 Cystitis, acute, 228-229-230
 — bladder calculus and, 228
 — bladder tuberculosis and, 229
 — bladder tumors and, 230, 231
 — chronic, 230
 — foreign bodies in bladder and, 228
 — gonorrheal, bladder tuberculosis and, 229
 — prostatic tumors and, 238
 Cystocele, 306
 — presence determined by tests, 306
 — uterine prolapse and, 298
 Cystography, diagnosis of tumors of round ligaments by, 294
 Cystoscopic examination, acute cystitis and, 230
 — bladder calculus and, 228

- Cystoscopic examination, bladder tuberculosis and, 229
- “bleeding kidney” and, 213
 - differentiating simple ulcer from tuberculous ulcer of bladder, 229
 - foreign bodies in bladder and, 228
 - kidney affections and, 208
 - prostatic hypertrophy and, 237
 - prostatic tuberculosis and, 236
 - tuberculosis of kidney and, 212
 - ureteral calculus and, 217
- Cysts, adenomatous, of liver, 716
- appendix, 647
 - blood, of face, 85
 - of humerus. *See* Aneurysm.
 - bone, 384, 397
 - Ashhurst classification of, 397
 - complicated by osteitis deformans, 397
 - spontaneous fracture in, 338
 - branchial, 128
 - breast, 172
 - broad ligament, 293
 - chocolate, ovarian, 291
 - chylous, of peritoneum, 606
 - congenital, of liver, 716
 - of umbilicus, 583
 - corpus luteum, ovarian, 291
 - dental root, 114
 - dermoid, 128
 - bladder, 231
 - breast, 172
 - liver, 716
 - lung, 187
 - mesenteric, 608
 - mouth, 103
 - neck, 142
 - ovarian, 291
 - penial, 254
 - peritoneal, 606
 - suppuration of, 107
 - thoracic wall, 156
 - tongue, 107
 - umbilical, 583
 - vaginal, 308
 - vulval, 310
 - echinococcus, abdominal wall, 580
 - breast, 172
 - humerus, 337
 - kidney, 215
 - liver, 716
 - lung, 187
 - neck, 129
 - thoracic wall, 153
 - vibratory thrill in, 129
 - epithelial inclusion, vaginal, 308
 - esophageal, 203
 - follicular, dentigerous or, 114
 - odontoma, 115
 - ovarian, 291
 - glandular, ovarian, 291
 - hemorrhagic, mesenteric, 608
 - ovarian, 291
 - peritoneal, 606
 - hydatid, muscle, 544
 - neck, 142
 - thyroid, 142
 - vaginal, 308
 - kidney, 214
 - pararenal, 215
- Cysts, kidney, parasitic, 214
- simple, 214
 - Kobelt's tubules, 293
 - lip, 99
 - liver, 716
 - lymphatic, breast, 172
 - mesenteric, 608
 - dermoid, 608
 - hemorrhagic, 608
 - parasitic, 608
 - serous, 608
 - mucous, tongue, 107
 - multilocular, ovarian, 291
 - neck, differential chart of, 130, 131
 - omentum, 611
 - ovarian, 290
 - abdominal enlargement caused by, differential chart of, 604
 - torsion, 652
 - pancreatic, 698, 725
 - abdominal enlargement caused by, differential chart of, 605
 - papillary, ovarian, 291
 - parasitic, lung, 187
 - mesentery, 608
 - skull, 55
 - tongue, 107
 - parathyroid, accessory, 141
 - parotid gland, 96
 - peritoneal, 606
 - chylous, 606
 - dermoid, 606
 - hemorrhagic, 606
 - serous, 606
 - pilonidal, 675
 - retention, breast, 172
 - parotid gland, 97
 - vaginal, 308
 - sebaceous, abdominal wall, 580
 - breast, 172
 - forearm, soft parts of, 342
 - hand and fingers, 341
 - neck, 127
 - penial, 254
 - rectum and anus, 675
 - shoulder, 329
 - thoracic wall, 156
 - umbilical, 583
 - vulval, 310
 - wrist, 344
 - serous, mesenteric, 608
 - peritoneal, 606
 - simple, humeral, 338
 - splenic, 709
 - blood, 707
 - dermoid, 707
 - echinococcus, 707
 - lymph, 707
 - serous, 707
 - testicle, 264
 - thyroglossal duct, 103, 128
 - tubo-ovarian, 289
 - umbilical, 583
 - congenital, 583
 - dermoid, 583
 - sebaceous, 583
 - vaginal symptom of, 308
 - vitello-intestinal duct, 583
 - vulval, 310
 - secondary infection, 311

- Dalrymple's sign, exophthalmic goiter and, 140
 Deafness, auditory nerve injury and, 66
 — corpora quadrigemina and, lesions of, 78
 — medulla and, lesions of, 79
 — pons and, lesions of, 79
 — skull fractures and, 446
 Death, acute erysipelalous stomatitis causing, 102
 — acute salpingitis causing, 295
 — anthrax causing, 340
 — emphysematous gangrene of leg causing, 356
 — gastritis causing, toxic, 615
 — histologically benign bladder tumors causing, 230
 — prostatic hypertrophy causing, 237
 — septic endometritis causing, 301
 — sudden, vagus nerve affections and, 66
 — tubal pregnancy causing, 296
 — uremia causing, in hydronephrosis, 214
 — — in kidney calculus, 214
 — uterine carcinoma causing, 300
 — uterine rupture causing, 298
 Deaver, on pancreatic inflammations, 688, 689, 711
 Deaver and Pfeiffer, on pancreatic inflammations, 711
 Defecation, history of, abdominal injury and, 569
 — pain on, bladder and prostate and seminal vesicle affections and, 224, 225
 — — genito-urinary tract affections and, 3
 — — prostatic calculi and, 236
 — — prostatic tuberculosis and, 236
 — — prostatic tumors and, 238
 — — prostatitis and, acute, 235
 — — vaginal carcinoma and, 309
 Deformans, arthritis, 431
 — osteitis, 397. *See also* Paget's disease.
 Deformity, acquired, foot and toes, 358
 — hand and fingers, 345
 — claw-hand, 335
 — congenital, joints, 418-422, 423
 — mouth, 101
 — foot, nerve lesions causing, 359
 — gun stock, fractures of humerus and, 478
 — "lion-like," 115
 — osteitis fibrosa cystica and, 398
 — Pott's disease and, 412
 — saddle-back, syphilis and, 111
 — "silver fork," 486
 — Sprengel's, of shoulder, 324
 Degeneration, cancerous, papilloma and, 107
 — reaction of, peripheral nerve injury and, 363
 Deglutition. *See* Swallowing.
 Delhi boil, 24
 Deltoid muscle, nerve supply of, *facing* 365
 — ossification of, 330
 — rupture of, 325
 Dentigerous cysts, 114
 Dermoid cyst, 128
 — bladder, 231
 — breast, 172
 — face, 85
 — liver, 716
 — lung, 187
 — mouth, 103
 — neck, 142
 Dermoid cyst, ovarian, 290, 291
 — penial, 254
 — peritoneal, 606
 — splenic, 707
 — thoracic wall, 156
 — thyroid, 142
 — tongue, 107
 — umbilical, 583
 — vaginal, 308
 — vulval, 310
 Desjardins, pancreatic point, 687
 Desmoid tumor, 546, 581
 Diabetes, carbuncle and, 120
 — lesions of medulla and, 79
 — predisposing cause in xanthoma, 41
 Diabetic gangrene, 32, 356
 Diaphragmatic hernia, 591
 Diaphragmatic pleurisy, differential chart of, 621
 Diarrhea, gastro-enteric tract affections and, 3
 — infectious, in children, 660
 — intestinal obstruction and, acute, 678
 — — chronic, 684
 — intussusception and, 682
 Dicondylar fracture of elbow, 476
 Dietl's crisis, *facing* 721
 — hydronephrosis and, 214
 — movable kidney associated with, 213
 Dieulafoy, ulceration of stomach of, 618
 — typhlitis of, 656. *See also* Appendicitis.
 Differential charts. *See* Contents.
 Dilatation, acute, stomach and, 616, chart 703
 — esophageal, 202
 Dimpling of skin, breast affections and, 168
 Diphtheria of prepuce, 255
 Diphtheritic enterocolitis, 659
Diplococcus intracellularis meningitidis. *See* Meningococcus.
 "Dipping," examination of kidney affections and, 208
 Discharge, cervix and, laceration of, 304
 — endometritis and, septic, 301
 — endometrium and, hypertrophy of, 303
 — osteomyelitis and, chronic, 388
 — uterus and, carcinoma of, 300
 — — sarcoma of, 301
 — vagina and, carcinoma of, 309
 — — gonorrheal inflammation of, 308
 — — sarcoma of, 309
 — vaginitis and, simple, 307, 308
 — vulva and, inflammation of, simple, 310
 — — malignant tumors of, 310
 Discharge material, examination of, 9
 Disease, Banti's, 705, 708
 — Barlow's, 393
 — Basedow's, 139. *See also* Exophthalmic goiter.
 — cardiac, chronic passive congestion of kidney and, 212
 — Chauffard-Minkowski's, 706
 — endocardial, renal infarct and, 212
 — Gaucher's, 706; chart, 709
 — Glenard's, 634, 713
 — Graves', 139. *See also* Exophthalmic goiter.
 — Hayem-Widal's, 706
 — Hirschsprung's, 659

- Disease, Hirschsprung's, chronic intestinal obstruction caused by, 684
- Hodgkin's, acute, in axilla, 16
 - of mediastinum, 162, 195
 - of neck, 132
 - Kohler's, 391, 392
 - Little's, 69
 - Morvan's, 433
 - neurologic, blood-vessel affections and, 72
 - Osgood-Schlatter's, 392
 - Paget's, 397
 - Pick's, 603
 - — mediastinopericarditis, adhesive, 194
 - Pott's, 411, 416, 665
 - Raynaud's, 346
 - Still's, 431, 432
 - von Mikulicz's, 84
 - von Recklinghausen's, 398
 - woolsorter's, 16
- Disk, choked. *See* Choked disk.
- Dislocations, 505
- ankle, 525, 526
 - atlas on axis, 507
 - carpal bone, 518, 519
 - — os magnum, 519
 - — scaphoid, 519
 - — semilunar, 518
 - carpometacarpal joint, 519
 - carpus, backward, Fig. 32, 519
 - clavicle, 147, 510, 511
 - — acromial end, 511, Fig. 30, 513
 - — sternal end, 510, Fig. 30, 513
 - — subcoracoid, 511
 - coccyx, 508
 - complete, 506
 - complicated, 506
 - compound, 506
 - congenital, 422, 506
 - — elbow joint, 338
 - — fibula, 352
 - — hip joint, 349
 - — knee, 422
 - — tibia, 352
 - — elbow, 514, 515, 516, 517
 - — backward, Fig. 31, 515
 - — fractures and, Chap. XII, 439
 - — hip, 521, 522, 523
 - — anterior, Fig. 34, 523
 - — backward, Fig. 33, 523
 - — central, 523
 - — Nélaton's line in, 422
 - — hip joint, Charcot's disease and, 350
 - — humerus, anterior, Fig. 30, 513
 - — knee, 523, 524
 - — lower jaw, 506, 507
 - — metacarpophalangeal joints, 520
 - — occiput on atlas, 507
 - — os magnum, 519
 - — partial, 506
 - — patella, 524, 525
 - — outward, 524, Fig. 35, 524
 - — pathologic, 506
 - — pelvis, 520, 521
 - — penis, 249
 - — peroneal tendon, 355
 - — phalangeal joints, 520
 - — radius, 517
 - — ulna and, 516, 517
 - — ribs, 509, 510
- Dislocations, sacro-iliac joint, 520
- sacrum, 508
 - scaphoid, 519
 - semilunar, 518
 - shoulder, 324, 512, 513, 514
 - shoulder joint, brachial plexus paralysis caused by, 364
 - sternum, 508, 509
 - tendons, 547
 - toes, 526
 - traumatic, 506
 - ulna, 516, 517
 - vertebrae, 507
 - — cervical, 507
 - — dorsal, 508
 - — lumbar, 508
 - wrist, 518
 - wrist joint, congenital malformation and, 343
- Dittrich's plugs, bronchiectasis and, 184
- Diverticulitis, large intestine, 662
- — S. G. Gant on, 662
 - — J. Mayo on, 662
 - — Telling on, 662
 - — sigmoid, 663, 664
- Diverticulum, bladder, 226
- bronchus, bronchiectasis and, 184
 - esophageal, 127, 202
 - — acquired, 202
 - — congenital, 202
 - — vomiting as cause of, 202
 - large intestine, 659
 - Meckel's acute intestinal obstruction caused by, 684
 - rectal, 673
 - ureteral, 217
- Donhauser, J. L., on malignant ovarian tumors in children, 290
- on omental fibromyoma, primary multiple on, 611
 - on pancreatitis, acute, 711
- Dorsalis pedis artery in intermittent claudication, 360
- Douglas, pouch of, abscess in, uterine displacement caused by, 298
- Ducts, Bartholin's, location of, 92
- biliary. *See* Biliary ducts.
 - omphalomesenteric, 606
 - — acute intestinal obstruction caused by, 684
 - — patent, 583
 - Rivini's, location of, 92
 - Stenson's, affections of, 91, 97
 - — differential chart of affections of, 94, 96, 97
 - — location of, 92
 - — thoracic, injury of, 196, 534
 - — rupture of, formation of chylothorax in, 186
 - thyroglossal, cyst of, 128
 - — fistula of, 126
 - vitello-intestinal, cyst of, 583
 - Wharton's, location of, 92
- Dugar's test for shoulder injury, 512
- Duodenum, affections of, Chap. XVIII
- tumors of, *facing* 628, 722, 723
 - ulcer of, *facing* 721
 - — abdominal examination in, 626
 - — chronic, 628 insert 1, 722, 723
 - — gastric contents, 626

- Duodenum, ulcer of, hematemesis in, differential chart of, 624-628
 - melena in, 628
 - stools in, 628
 - Dupuytren's contracture, 345
 - differentiated from congenital contraction, 345
 - Dura. *See* Meninges.
 - Dwarf, in cretinism, 351
 - Dynamic ileus. *See* Mechanical ileus.
 - Dysarthria, medulla and, affections of, 79
 - pons and, affections of, 79
 - Dysentery, amebic, 660
 - bacillary, 660
 - Heuyer and Leveuf on, 661
 - Martin and Williams on, 661
 - Dysmenorrhea, cervical polypi in, 304
 - cysts of broad ligaments in, 293
 - uterine displacements and, 298
 - Dyspareunia, 312
 - Dysphagia, cardiospasm and, 614
 - esophageal conditions and, 201
 - esophageal diverticulum and, 128
 - foreign bodies of esophagus and, 200
 - gastritis and, toxic, 615
 - goiter and, 137
 - Hodgkin's disease and, 132
 - mediastinal affections and, 193
 - inflammatory, 194
 - medulla and, affections of, 79
 - phlegmonous esophagitis and, 200
 - pons and, affections of, 79
 - progressive, esophageal strictures and, 202
 - retropharyngeal abscess and, 122
 - retrosternal goiter and, 195
 - sarcoma of cervical lymph glands and, 133
 - vagus nerve affections and, 66
 - Dysphonia, vagus nerve affections and, 66
 - Dyspnea, breast and, malignant conditions of, 166
 - acute submental adenitis and, 122
 - cardiospasm and, 614
 - empyema and, 183
 - esophageal injury and, 200
 - goiter and, 137
 - Hodgkin's disease and, 132, 162
 - lung injury and, 147
 - malignant tumors of lungs and thorax and, 190
 - mediastinal affections in, 193
 - inflammatory, 94
 - ovarian tumors in, 290
 - pericarditis with effusion and, 178
 - pleurisy and, 184
 - respiratory tract affections and, 3
 - retropharyngeal abscess and, 122
 - retrosternal goiter and, 195
 - sarcoma of thoracic wall and, 157
 - spontaneous rupture of esophagus and, 203
 - sternal fracture and, 147
 - thymus gland enlargement and, 193
 - thyroid affections and, 135
 - thyroiditis and, woody, 136
 - tobacco history and, 4
 - Dystocia, accompanying uterine myomata, 299
 - Dystrophy, bone, 384, 393
 - pseudohypertrophic muscular, vertebral column in, 416
 - Dysuria, sarcoma of penis and, 255
 - Dysuria, ureteral stricture and, 217
 - urethral tuberculosis and, 258
 - uterine displacements and, 298
 - Ear, hemorrhage from, skull fracture and, 446
 - Eastman, N. J., on hydrosalpinx, 296
 - Echymosis, conjunctival traumatic asphyxia and, 148
 - head injury and, 51
 - Echinococcus affections, 24
 - Echinococcus cysts, abdominal wall, 580
 - breast, 172
 - humerus and, 337
 - spontaneous fracture of, 337
 - kidney, 214
 - liver, 716
 - lung and, sputum in, 187
 - neck, 129
 - pelvis, 294
 - skull, 55
 - spleen, 707
 - thoracic wall, 153
 - vibratory thrill in, 129
 - Ectopic pregnancy, 296, 694, 695. *See also* Tubal pregnancy.
 - Ectopic spleen, 704
 - Ectrodactylia, 344
 - Eczema, chronic, scrotal, 262
 - — — scrotal epitheliomata caused by, 264
 - Edema, breast affections and, 169
 - secondary to carcinoma of armpit, 163
 - axillary, 159
 - cerebral, skull fractures and, 446
 - eyelid, cavernous sinus thrombosis and, 63
 - forehead, superior longitudinal sinus thrombosis and, 63
 - glottis, foreign bodies of esophagus and, 200
 - hand, breast affections and, 169
 - leg, cysts of broad ligaments causing, 293
 - loin, kidney affections and, 208
 - malignant, 20
 - mastoid region, lateral sinus thrombosis and, 63
 - mediastinal affections and, 193
 - nephritis causing, 262
 - osteomyelitis and, acute, 388
 - subacute, 388
 - penial, ivy poisoning and, 250
 - phlegmasia alba dolens and, 352
 - scrotal injury causing, 262
 - shin, liver cirrhosis and, 629
 - upper extremity, subclavian aneurysm and, 127
- Ejaculation, pain on, acute vesiculitis and, 238
- Elbow, affections of, 338, 340
 - aneurysm at site of, 340
 - antrax of, 340
 - "carrying angle," 478
 - Charcot's disease of, 339
 - congenital anomalies of, 338
 - contracture of, 340
 - contusions of, 338
 - diseases of, 339, 340
 - dislocations of, 338, 514-517
 - embolism about, 340
 - epithelioma of, 340

- Elbow, fibroma of, 340
 —foreign bodies of, 339
 —fractures of, 474-482
 —inflammatory conditions of, 339, 340
 —injuries of, 338, 340
 —lipoma of, 339, 340
 —miner's, 336
 —osteoma of, 340
 —pulled, 339, 517
 —rupture of synovial membrane preceding lipoma of joint, 339
 —sarcoma of, 340
 —sprains of, 338
 —syphilis of, 339
 —thrombosis about, 341
 —tuberculosis of, 339, 340
 —wounds of, 338, 340
 Electrical reactions in peripheral nerve injuries, 363
 Elephantiasis, 535
 —habitat in foreign countries and, 261
 —leg, 356
 ——lymphatic inflammation causing, 356
 ——malignancy causing, 356
 —penial, 251
 —removal of inguinal glands causing, 356
 —scrotal, 263
 —vulval, 311
 Elting, A. W., on abscess of spleen, 702
 Embolic gangrene, 32
 Embolism, arterial, 530
 —cerebral, 73
 —elbow, 340
 —leg, soft parts of, 356
 —pulmonary, postoperative, 187
 —splenic vessels, 704
 —thigh, 352
 —upper arm, 336
 —vein, 532
 Emissions, frequent, chronic vesiculitis and, 239
 —nocturnal, bladder and prostate and seminal vesicle affections in relation to, 224
 ——chronic vesiculitis and, 239
 ——genito-urinary tract affections and, 3
 Emphysema, subcutaneous, fractures of nasal bones and, 449
 ——head injury and, 51
 ——lung injury and, 147
 ——pneumothorax and, 186
 ——spontaneous rupture of esophagus and, 263
 Emphysematous gangrene, hand, 341
 —thigh, 352
 —upper arm, soft parts of, 335
 Empyema, gall-bladder, 720
 —thoracic, 183
 Empyema necessitatus, 183
 Encephalitis, acute, 70
 —chronic, 71
 ——bulbar form, 71
 ——progressive ophthalmoplegia, 71
 Encephalocele, 54
 Endocarditis, lung infarct, 187
 Endocervicitis, 301, 302
 —Miller, C. J., on, 302
 Endometritis, gonorrheal, 301
 ——associated inflammation of Skene's glands, 301
 Endometritis, associated inflammation of urethra, 301
 ——*See also* Gonorrheal inflammation of uterus.
 —septic, death from, 301
 ——etiology of, 301
 ——symptoms of, 301
 —tuberculous, 301
 ——secondary to tuberculosis elsewhere, 301
 Endothelioma, 42
 —brain, 79
 —breast, 174
 —Ewing's tumor, differential chart of, 402, 403
 —face, 90
 —intestine, 666
 —kidney, 215
 —lung, 187
 —neck, 142
 —omental, 611
 —parotid gland, 93, 96
 —penial, 255
 —peritoneal, 606
 —rectum and anus, 676
 —stomach, 630
 —tongue, 107
 —uterine, 209
 Enophthalmos, 456
 Enostoses, 41, 396
 Enteritis, acute, 633, 648
 ——stools in, 633
 —chronic, 633, 634
 ——stools in, 634
 Enterocoele, 596
 Enterocolitis, acute catarrhal, 659
 —acute diphtheritic, 659
 —acute phlegmonous, 659
 —ulcerative, 659
 Entero-epiplocele, 596
 Enteroliths, 632
 Enteroptosis, 634
 Enuresis, neuroses of bladder and, 234
 Eosinophilia in Hodgkin's disease, 132, 538
 Epidemics, noma and, 82
 Epididymis, affections of, 258
 —inflammatory conditions of, 262
 ——acute, acute infectious diseases and, 260
 ——fever in, 261
 ——gonorrhea and, 260
 ——instrumentation and, 261
 ——mumps and, 261
 —tuberculosis of, 263, 264
 ——hydrocele and, 262
 ——hydrocele differentiated from, 263
 ——scrotal sinuses in, 264
 ——urination, increased frequency of, 264
 Epigastric hernia, 591, 620, 628
 Epigastric pain in, acute, 620-621
 —chronic, 628-629
 —skull fracture complicated by, 447
 —symptomatic, 75
 Epilepsy, 75
 —idiopathic, 75
 Epiphora, fractures of nasal bones and, 448
 Epiphysis, separations of, "soft crepitus" and, 487
 —ulnar separation of, 485. *See also* under Fractures.
 Epiphysitis, os calcis, 392
 —vertebral, 392, 409

- Epiplocele, 596
 Epispadias, 248
 Epithelioma, 42
 — adamantine, 115
 — elbow, soft tissues of, 340
 — face, 90
 — forearm, 342
 — hand and fingers, 347
 — lip, 99
 — rectum and anus, 675
 — scrotal, chronic eczema causing, 264
 — habitat in foreign countries in relation to, 261
 — smoking as etiologic factor of, 90
 — testicle, 264
 — upper arm, 335
 — vaginal, 309
 Epitrochlear lymph glands, syphilis and, 337
 Epulis, jaw, 112
 — fibrous, 112
 — giant-cell, 112
 — sarcoma and, 112
 Erb-Duchenne paralysis, upper arm, 364
 Erb's birth-palsy, 423
 Erb's paralysis, 22
 Erections, defective, chronic cavernitis and, 250
 — frequent, bladder and prostate and seminal vesicle affections and, 223
 — imperfect, bladder and prostate and seminal vesicle affections and, 224
 — painful, chronic prostatitis and, 236
 — genito-urinary tract affections and, 3
 — prostate and seminal vesicle affections and, 223
 — persistent, acute vesiculitis and, 238
 — urethral calculus and, 257
 Erdman, J. T., on papillary cysts of ovary, 291
 Ergot, gangrene caused by, 32
 Erysipelas, 16, 48
 — face and, 82
 — hand and, 347
 — penis and, 255
 — rash of, 16
 — *Streptococcus hæmolyticus* and, 16
 — thigh and, 351
 — umbilicus and, 582
 — upper arm and, soft parts of, 335
 Erythrocytes, 739
 Esophagus, affections of, 198
 — chart of, regional, 198, 199
 — dilatation of, 202
 — diverticulum of, 127, 128, 202
 — Plummer's silk thread test in, 128
 — fissures of, 203
 — foreign bodies in, 200
 — history of, 199
 — inflammatory conditions of, 200
 — injuries of, 148, 200
 — perforation of, 200, 203
 — rupture of, spontaneous, 202, 203
 — spasm of, 203
 — strictures of, 201, 202
 — tumors of, 203, 204
 — sarcoma, Keen on, 204
 — ulcerations of, inflammatory, 201
 — secondary to malignant disease, 201
 — syphilitic, 201
 — varix of, 203, 625, 629
 Esophagus, varix of, abdominal examination in, 627
Eustrongylus gigas, disease of kidney and, 215
 Eversion of intracervical mucosa, 305
 Ewing's tumor, endothelioma and, differential chart of, 402, 403
 Examination, ascites and, 355
 — bimanual, hernia of uterus and, 303
 — subinvolution of uterus and, 303
 — blood, 8
 — fresh, 740
 — discharge material, 9
 — excised tissue, 9
 — fluid, abdominal, 9
 — swelling and joint, 9
 — thoracic, 9
 — injury and, abdominal, 567
 — head, 51, 52
 — joint affections and, 422
 — kidney, 206
 — lymph gland enlargement, 538
 — membranous exudate, 9
 — pancreatic, 687
 — peripheral nerve injuries and, 361
 — Pott's disease and, 412
 — prostatic, 234
 — spinal fluid, 8, 9
 — splenic, 701
 — sputum, 8
 — stool, 8
 — tumor, 37, 38
 — urine, 7, 8
 — vertebral column, 407-409
 Exophthalmic goiter, 138-141
 — acidosis in, 141
 — changes in metabolism and, 140
 — Dalrymple's sign in, 140
 — glycosuria in, 141
 — Goetsch adrenalin test in, 140
 — visible pulsation in, 135
 — Moebius' sign, 140
 — Plummer on, 140
 — Stellwag's sign, 140
 — symptom-complex in, 139
 — thyrotoxicosis in, 138
 — von Graefe's sign in, 140
 Exophthalmos, cavernous sinus thrombosis and, 63
 — exophthalmic goiter and, 139
 — pulsating, 62, 530
 Exostoses, 41, 396, 399
 — humeral, 338
 — phalangeal, 348
 — scapular, 331
 — skull, 55
 Expectoration, malignant tumors of lungs and pleuræ and, 190
 — phlegmonous esophagitis and, 200
 — pulmonary abscess and, 183
 — postural effect on, 183
 Exstrophy of bladder, 225
 Extraparietal hernia, 588
 Extremities, Chap. IX, 313
 — affections of, anatomic chart of, 313-324
 — examination of, head injury and, 52
 Eyeball, abducens nerve injury and, 65
 — deviation of, oculomotor nerve injury and, 63

- Eyeball, pain in, sarcoma suggested by, 90
 Eyes, affections, tobacco history and, 4

 Face, abscess of, 82
 — actinomycosis of, 82
 — acute cellulitis of, 82
 — adenoma of, 85
 — affections of, 81
 — — regional chart of, 81, 82
 — anthrax of, 84
 — basal cell carcinoma of, 90
 — blastomycosis of, 82
 — carbuncle of, 82
 — carcinoma of, 90
 — cirroid aneurysm of, 85
 — comedo of, 85
 — cysts of, blood, 85
 — — cystic hemangioma, 85
 — — cystic lymphangioma, 85
 — — dermoid, 85
 — — retention, 85
 — — sebaceous, 85
 — diseases of, differential chart of, 86, 87, 88, 89
 — endothelioma of, 90
 — epithelioma of, 90
 — erysipelas of, 82
 — fibroma of, 85
 — furuncle of, 82
 — glanders of, 84
 — granulomata of, 82
 — hemangioma of, 85
 — hypertrophy of bones of, 386
 — inflammations of, 82
 — keloid of, 85
 — leprosy of, 83
 — lipoma of, 85
 — lupus of, "serpiginous advancement" of, 83
 — milium of, 85
 — mixed tumors of, 90
 — myxoma of, 85
 — noma of, 82
 — osteoma of, 85
 — papilloma of, 85
 — rodent ulcer of, 90
 — sarcoma of, 90
 — syphilis of, 83
 — tuberculosis of, 83
 — tumors of, benign, 85, 90
 — — malignant, 90, 91
 — von Mikulicz's disease of, 84
 — xanthoma of, 90
 Facial nerve, injury of, 65
 Facial palsy, facial nerve injury and, 66
 — skull fractures and, 446
 Fallopian tubes, affections of, 294
 — inflammation of. *See* Salpingitis.
 — malformations of, 294
 — tubal patency tests in, 296
 — tubal pregnancy and, 296
 — tuberculosis of, ovarian tuberculosis and, 289
 — tumors of, 296
 "False passage" of urethra, 255
 — instrumentation and, 261
 False meningocele, 47. *See also* Cephalhematoma.
 Faradic current reactions in peripheral nerve injury, 363
 Farcy, 24, 111
 Fascia, plantar, leg, rupture of, 355
 — tensor, femoris, nerve supply of, 374
 — — — paralysis of, 380
 Fat necrosis, 600
 Fecal concretions in small intestine, 632
 Fecal impaction, 664
 Feces, incontinence of, vaginal injuries and, 306
 Female genital organs, Chap. VIII, 282
 — affections of, regional chart of, 282-285
 Femoral hernia, 588, 597
 Femoral region, swelling of, aneurysm and, 597
 — — chart of, differential, 597
 — — glands and, enlarged, 597
 — — hernia and, femoral, 597
 — — hip and, osteo-arthritis of, 597
 — — hip joint and, tuberculosis in, 597
 — — percussion of, 7
 — — vein varicosity and, 597
 Femur, fractures of, 351, 492, 498
 Fetal adenoma in thyroid gland, 139
 Fetal uterus, 297
 Fever. *See* Temperature.
 Fibrocystadenoma, breast, 173
 Fibrocystic disease, testicle, 264
 Fibroma, abdominal wall, 581
 — bladder, 231
 — bone, 399
 — brain, 79
 — broad ligament, 293
 — durum, 38
 — elbow, soft tissues of, 340
 — esophageal, 204
 — face, 85
 — fallopian tube, 296
 — forearm, soft parts of, 342
 — hand and fingers, 347
 — jaw, 111
 — kidney, 215
 — large intestine, 663
 — lung, 187
 — mesenteric, 608
 — molle, 38
 — mouth, 103
 — muscle, 546
 — ovarian, 290
 — ovarian ligament, 293
 — papillary, 38
 — parotid gland, 93
 — penial, 254
 — periductal, breast, 173
 — peritoneal, 606
 — prostatic, 237
 — rectum and anus, 675
 — round ligament, 294
 — scapular, 331
 — shoulder, 329
 — stomach, 622
 — tendons, 549
 — testicle, 264
 — thigh, soft parts of, 352
 — thoracic wall, 154
 — tongue, 107
 — tuberos, 38
 — umbilical, 583
 — uterine, 299
 — vulval, 310
 — wrist, soft tissues of, 344

- Fibroma molluscum, 39. *See also* Von Reck-linghausen's disease.
- Fibromyoma, 39
- primary, multiple, omentum and, 611
 - vaginal, 308
- Fibrosis, chronic, parotid gland and, 92
- Fibula, congenital dislocation of, 352
- fracture of, 501, 502
 - middle third, Fig. 27, 502
- Filaria sanguinis hominis*, disease of kidney and, 215
- elephantiasis of leg caused by, 356
 - filariasis caused by, 24
 - surgical affections caused by, 28
- Filariasis, 24
- Fingers, affections of, 344-349
- Fissure, anal, 669
- Fistula, anal, 669
- branchial cleft, 126
 - — symptom-complex of, 126
 - neck, 126
 - — congenital, 126
 - parotid gland, 97
 - perineal, 225, 258
 - — tuberculous vesiculitis complicated by, 240
 - rectal, etiology of, 225
 - — tuberculous vesiculitis complicated by, 240
 - — vaginal carcinoma and, 309
 - rectovaginal, 307
 - salivary, etiologic factor in chronic diffuse inflammation of parotid gland, 92
 - scrotal, 258
 - Stenson's duct, 98
 - thyroglossal duct, 126
 - — symptom-complex of, 126
 - umbilical, 583
 - — from bladder, 226
 - urethral, 258
 - — vesical fistula differentiated from, 227
 - urethropehile, 258
 - urinary, vaginal carcinoma and, 309
 - vaginal, 307
 - — accompanying malignancy, 307
 - vaginorectal, malformations of vagina and, 305
 - vesical, 226
 - — tuberculous vesiculitis complicated by, 240
 - — urethral fistula differentiated by, 227
 - vesico-abdominal, 227
 - vesicoperineal, 227
 - vesicovaginal, 226, 307
- Fitz, Reginald, on acute pancreatitis, 688
- Florey, H., and Carleton, H. M., on omentum, 610
- Fluid, abdominal, examination of, 9
- joints and swellings, examination of, 9
 - seminal, acute vesiculitis and, 238
 - — urethral tuberculosis and, 258
 - thoracic, examination of, 9
- Fluoroscopy, diagnosis aided by, 710, 720, 721, 723, 725
- Follicular cysts, compound or composite, odontoma, 115
- ovarian, 291
- Foot, club-, 357
- toes and, affections of, 358-360
 - — intermittent claudication of, 360
- Forearm, affections of, chart 316-317; 341-343
- fractures of, 482
- Foreign bodies, biliary ducts and, 727
- bladder and, 228
 - elbow joint and, 339
 - esophagus and, 200
 - knee joint and, 353, 434-436
 - lungs and pleurae and, 182
 - rectum and, 671
 - small intestine and, 632, 633
 - Stenson's duct and, 98
 - tongue and, 105
 - urethra and, 257
- Fractures, acetabulum, 492, 495
- age in relation to, 439
 - ankle, 502
 - astragalus, 503
 - Bennett's, 488
 - bony thorax, 146
 - calipers in, use of, 442
 - capitellum, 477
 - carpus, 487
 - cervical spine, 455
 - classification of, according to direction, 439
 - — anatomic, 439
 - — comminuted in, 439
 - — complicated in, 441
 - — compound in, 440
 - — etiologic, 439
 - — greenstick in, 441
 - — gunshot in, 439
 - — impacted in, 440
 - — infraacted in, 440
 - — longitudinal in, 439
 - — non-impacted in, 440
 - — oblique in, 439
 - — penetrating in, 439
 - — simple in, 440
 - — spiral in, 439
 - — stellate in, 439
 - — T-fracture in, 439
 - — transverse in, 439
 - clavicle, 147, 364, 459-462
 - — middle third, Fig. 5, 460
 - Colles', 485, Fig. 17, 485; Fig. 18, 486
 - contrecoup, 439
 - coronoid process, 482
 - costal cartilages, 463. *See also* Fractures, rib.
 - cribriform plate of ethmoid, olfactory nerve injury and, 63
 - cuneiform, 504
 - definition of, 439
 - dislocations and, Chap. XII, 439
 - elbow, 474-481
 - etiology of, 439
 - examination of, inspection in, 441
 - — palpation in, 441
 - femur, 351, 492, 493, 498
 - — greater trochanter in, 496
 - — head and neck in, 494
 - — internal and external condyle in, 498
 - — intertrochanteric fractures in, Fig. 22, 495
 - — lesser trochanter in, 496
 - — lower end in, 498
 - — lower epiphysis in, 499
 - — measurements in, 493

- Fractures, femur, shaft in, 496-498
 ——— upper third of, Fig. 23, 496
 ——— shortening in, apparent, 493
 ——— real, 493
 ——— supracondylar, 498
 ——— trochanters in, 495
 ——— upper end, examination of, 493
 ——— upper epiphysis in, 495
 ——— fibula, upper end in, 501
 ——— forearm, 483
 ——— frequency of, 439
 ——— heredity in relation to, 439
 ——— history of, 441
 ——— humerus, 465-478
 ——— brachial plexus paralysis caused by, 364
 ——— greater tuberosity in, Fig. 9, 468
 ——— gunstock deformity in, 478
 ——— lower end in, 478
 ——— neck in, Fig. 30, 513
 ——— shaft in, comminuted, Fig. 13, 473
 ——— fissured, Fig. 12, 473
 ——— supracondylar, 475; Fig. 14, 475
 ——— surgical neck in, impacted, Fig. 10, 470
 ——— non-impacted, Fig. 11, 470
 ——— upper end in, 466
 ——— Volkmann's contracture in, 478
 ——— Volkmann's ischemic paralysis in, 478
 ——— hyoid bone, 452
 ——— inferior maxilla, 450
 ——— knee and lower leg, 500
 ——— malar bone, 447
 ——— measurements of, examination and, 442
 ——— metacarpal bones, 488
 ——— metatarsal bones, 504
 ——— nasal bones, 448
 ——— os calcis, 503; Fig. 29, 503
 ——— patella, 499; Fig. 26, 499
 ——— pelvis, 490
 ——— acetabulum, 492
 ——— anterior superior spine in, 491
 ——— bladder injuries in, 492
 ——— coccyx in, 492
 ——— double fracture of Malgaigne in, 491
 ——— ilium in, 491
 ——— injury in, abdominal wall, 576
 ——— peritonitis complicating, 492
 ——— rami in, 491; Fig. 20, 491
 ——— sacrum in, 492
 ——— symphysis in, 492
 ——— urethral injuries in, 492
 ——— penis, 248
 ——— phalanges, 489
 ——— fracture of finger and, Fig. 19, 489
 ——— Pott's, 502; Fig. 28, 503
 ——— "punch," 488
 ——— radiography in, 442
 ——— radius, 479-487
 ——— head of, Fig. 15, 479
 ——— ulna and, 479
 ——— lower third, Fig. 16, 483
 ——— ribs, 146, 463
 ——— scaphoid, 504
 ——— scapula, 464
 ——— brachial plexus paralysis caused by, 364
 ——— neck in, Fig. 30, 513
 ——— surgical neck in, Fig. 8, 464
 ——— sex in relation to, 439
 Fracture, shoulder joint, brachial plexus paralysis caused by, 364
 ——— skull, 442-447
 ——— dislocation of jaw complicated by, 507
 ——— spine, 453. *See also* Fractures, vertebræ.
 ——— spontaneous, carcinoma of humerus and, 338
 ——— cyst of humerus and, 338
 ——— echinococcus, 337
 ——— myeloma and, 156
 ——— osteitis fibrosa cystica and, 398
 ——— sternum, 147, 462
 ——— superior maxilla, 449
 ——— tape measure in, use of, 442
 ——— tarsal bones, 503
 ——— temporal bone at base of skull, associated with auditory nerve injury, 66
 ——— thyroid cartilage, 453
 ——— tibia and fibula, lower end in, 501-503
 ——— middle third, Fig. 27, 502
 ——— tibial tubercle, 501
 ——— toes, phalangeal bones of, 505
 ——— types of, Fig. 3, 440
 ——— ulna, 480-485
 ——— radius and, 479
 ——— vertebræ, 453, 459
 ——— coccygeal, 457
 ——— dorsal, 456
 ——— involvement of spinal cord in, 458
 ——— lumbar, 456
 ——— reflexes in, cutaneous, 459
 ——— tendon, 459
 ——— sacral, 457
 ——— wrist region, 485
 Fragilitas ossium, 395
 Friction rub, pericarditis with effusion and, 178
 ——— pleurisy and, 184
 Froment, on ulnar nerve paralysis, 372
 Frontal lobe, brain, 77
 Fungi, affections caused by, 28
 Furuncle, 13
 ——— abdominal wall, 578
 ——— axilla, 159
 ——— elbow, soft tissues of, 340
 ——— face, 82
 ——— hand, 347
 ——— neck, 120
 ——— scalp, 48
 ——— thigh, 351
 ——— thoracic wall, 151
 ——— upper arm, 335
 Furunculosis, acute diffuse, multiple in axilla, 159
 ——— thoracic wall, 151
 Galactocoele, breast, 172
 Gall-bladder, Chap. XXIII, 718
 ——— affections of, regional chart of, 718
 ——— calculus in, 720, 721
 ——— carcinoma of, 722, 723
 ——— empyema of, 720
 ——— examination of, 718
 ——— hydrops of, 721
 ——— inflammations of, 719, 720
 ——— injury of, 573, 719
 ——— malformations of, 719
 ——— perforation of, 696, 697
 ——— Robson's point in, 718
 ——— strawberry, W. C. MacCarty on, 719

- Gall-bladder, *tænia* in, 721
 — torsion of, 721
 — traumatic rupture of, 573
 — tumors of, 720
 Gall-stones, 720, 721
 — cholecystitis and, chronic purulent, 720
 — diagnosis of, 729
 — obstructing small intestine, 633
 Galvanic current reactions in peripheral nerve injury, 363
 Ganglia, basal, 78
 Ganglion, 549
 — tendon sheaths of wrist and, 344
 Gangrene, Chap. II, 13; 29
 — *ainhum*, 32
 — artery injury followed by, 528
 — bed-sores and, 32
 — carbolic acid and, 32
 — chemical forms of, 31
 — chemicals causing, 32
 — diabetic, 32
 — — toes and leg and, 356
 — — differential chart of, 32
 — dry, 30
 — embolic, 32
 — emphysematous, 356
 — — hand and, 347
 — — leg and, 356
 — — thigh and, 352
 — — toxemia in, 356
 — — upper arm and, soft parts of, 335
 — ergot causing, 32
 — etiology of, 29, 30
 — gas, 19
 — leg, fractures of femur complicated by, 498
 — — diabetic, 356
 — — frost-bite causing, 356
 — — pressure causing, 357
 — — Raynaud's symmetric, 356
 — — soft parts of, 356
 — — thrombo-angiitis obliterans followed by, 356
 — — traumatic, 356
 — lung, 184
 — — putrid breath in, 184
 — moist, 30
 — mummification and, 30
 — noma, 32, 82
 — pathologic varieties of, 30
 — — dry, 30
 — — moist, 30
 — penis and, 249
 — presenile, 32
 — Raynaud's disease and, 32, 346, 356
 — senile, 32
 — spleen and, 705
 — traumatic, leg and, 356
 — umbilicus and, 582
 Gangrenous stomatitis. *See* Noma.
 Gant, S. G., on diverticulitis of large intestines, 662
 Gas gangrene, 19
 Gastric anthrax, 16
 Gastric carcinoma, 622-630. *See also* Stomach, carcinoma of.
 Gastric contents, achlorhydria and, 616
 — achylia gastrica and, 616
 — duodenal ulcer and, 626
 — esophageal varix and, 627
 — gastric ulcer and, acute, 626
 Gastric contents, gastric ulcer and, chronic indurated, 620, 626
 — gastritis and, chronic, 616
 — liver cirrhosis and, 627
 — stomach carcinoma and, 629
 Gastric crisis. *See* Tabes dorsalis, *facing* 628.
 Gastric dilatation, gastritis and, acute, 615
 — stomach carcinoma and, 628
 Gastric syphilis, achlorhydria in, 616
 Gastric ulcer, *facing* 721
 — acute, abdominal examination of, 619, 626
 — — gastric contents and, 619, 626
 — — hematemeses in, 618, 624-628
 — — melena in, 628
 — — pain in, 618, 624
 — — pyloric obstruction and, 619
 — — stomach tube inadvisable in, 628
 — — type of, fulminating, 618
 — — — severe, 619
 — — — slight with hematemeses, 619
 — — vomiting in, 618, 619
 — chronic indurated, 619
 — — abdominal examination in, 620, 626
 — — dyspepsia in, persistent, 619
 — — gastric contents in, 620, 626
 — — hematemeses in, 619, 624-628
 — — melena in, 628
 — — pain in, 619, 624
 — — vomiting in, 619
 — — with stenosis, 619
 — — without stenosis, 619
 — superficial, Dieulafoy's, 618
 Gastrica, achylia, 616
 Gastritis, acute, 614, 615, 620
 — chronic, 615, 616, 617, 628
 — phlegmonous, 615
 — signs of, alcoholic history and, 4
 — simple, 614
 — toxic, 615
 Gastrocnemius muscle, nerve supply of, 375
 — tibial nerve paralysis and, 378
 Gastro-enteritis, acute, 694, 695
 Gastro-intestinal perforation, 696-697
 Gastro-intestinal tract, affections of, regional chart of, 638, 639
 — injury of, 572
 Gaucher's disease, 706; chart, 709
 — Mandelbaum and Brill on, 706
 Genito-urinary tract, affections of, history of, 3
 — male, Chap. VII, 205
 Glanders, face and, 84
 — granulomatous infection of, 24
 — lip and, 99, 100
 — lung and, 185
 — occupation and, 84
 — ulceration in, 84
 Glandular fever, lymph glands in, 539
 Glass, on cholelithiasis, 691
 Gleet, persistent, urethral stricture caused by, 247
 Glenard's disease, 634, 713
 Glenard's procedure, palpation of kidney and, 206
 Glioma, 39
 — brain, 79
 Glossitis, acute, 106
 — acute parenchymatous, 105
 Glossopharyngeal nerve, injury of, 66
 Gluteal nerve, inferior, 375

- Gluteal nerve, inferior, paralysis of, muscles involved in, anatomic chart of, 381
- superior, 374, 375
 - paralysis of, muscles involved in, anatomic chart of, 380
- Gluteus maximus muscle, 375
- nerve supply of, 375
 - paralysis of, 381
- Gluteus medius muscle, 375
- nerve supply of, 375
 - paralysis of, 380
- Gluteus minimus muscle, 375
- nerve supply of, 375
 - paralysis of, 380
- Glycosuria, exophthalmic goiter and, 141
- head injury and, 52
 - pancreatic disease and, 689
- Goetsch adrenal test, exophthalmic goiter and, 140
- Goiter, 137
- adenomatous, 138, 139
 - bruit in hemorrhage into a preëxisting, 135
 - “butterfly” appearance in, 137
 - carcinoma of thyroid in preëxisting, 143
 - colloid, 138, 139
 - cystic, 138
 - dysphagia in, 137
 - dyspnea in, 137
 - exophthalmic, 138, 139
 - acidosis in, 141
 - cerebral symptoms in, 140
 - changes in metabolism and, 140
 - Dalrymple’s sign in, 140
 - exophthalmos in, 139
 - glycosuria in, 141
 - Goetsch’s adrenal test in, 140
 - Moebius’ sign in, 140
 - Plummer on, 140
 - Stellwag’s sign in, 140
 - symptom-complex in, 139
 - thyrotoxicosis in, 138
 - visible pulsation in, 135
 - von Graefe’s sign in, 140
 - hoarseness in, 137
 - malignant, 142
 - metastatic colloid, 139
 - parenchymatous, 138
 - preëxisting, carcinoma of thyroid developing in, 143
 - retrosternal, 137, 195
 - cyanosis in, 137
 - dysphagia in, 195
 - dyspnea in, 195
 - enlargement of veins of thoracic wall in, 137
 - mediastinum in, 195
 - retrasternal dullness in, 137
 - simple parenchymatous, 139
 - nervousness in, 139
 - thrill in hemorrhage into preëxisting, 135
 - vascular, 135
- Gonococcus, surgical affections caused by, 20, 26
- Gonorrhea, achillobursitis caused by, 360
- acute, joints in, 431
 - acute epididymitis and, 260
 - acute inflammation of spermatic cord and, 260
 - acute prostatitis caused by, 235
- Gonorrhea, acute vesiculitis caused by, 238
- bladder, prostate and seminal vesicle affections and, 221
 - chronic joints in, 431
 - hydrocele complicating, 260
 - joints in, 431
 - ovarian inflammatory conditions caused by, 286
 - prostatorrhea and, 236
 - salpingitis caused by, 295
- Gonorrheal inflammation, hip joint and, 350
- knee joint and, 353
 - shoulder joint and, 332
 - uterus and, 301
 - vagina and, 308
- Gonorrheal spondylitis, vertebral column and, 413
- Gonorrheal tenosynovitis, hand and fingers and, 347
- Gout, achillobursitis caused by, 360
- bladder, prostate and seminal vesicle affections and, 221
 - joints in, 426
 - hand, 349
 - hip, 350
 - symptoms of simple inflammation of uterus attended by, 301
 - tophi in, 349
- Gouty ulcer, 35
- Gracilis muscle, nerve supply of, 374
- paralysis of, 382
- Granulomata, abdominal wall and, 580
- appendix and, 647
 - axilla and, 159
 - bladder and, 229
 - bone and, 384, 389
 - brain and, 74
 - breast and, 171
 - bursæ and, tuberculosis of, 551
 - elbow joint and, 339
 - face and, 82
 - hand and fingers and, 347
 - humerus and, 337
 - large intestine and, 661
 - jaw and, 111
 - kidney and, 211
 - liver and, 717
 - lymphatics and, 535
 - mediastinum and, 194
 - mesentery and, 607
 - mouth and, 103
 - muscles and, 543
 - neck and, 128
 - ovary and, 289
 - pancreas and, 698
 - parotid gland and, 92
 - penis and, 252
 - rectum and anus and, 670
 - scapular and, 331
 - serotum within, 263
 - shoulder joint and, 332
 - small intestine and, 636
 - spleen and, 704
 - stomach and, 621
 - tendons and, 548
 - thyroid gland and, 136
 - tongue and, 106
 - ureter and, 216
 - urethra and, 257
 - vertebral column and, 406

- Granulomatous infections, 22
 Graves' disease, 139. *See also* Exophthalmic goiter.
 Great sciatic nerve paralysis, 377
 Greenstick fractures, 441
 Groca's paravertebral triangular area of dullness, pleural cavity affections and, 186
 Grouping of blood, 740
 Guinea-pig inoculation, bladder tuberculosis and, 229
 —tuberculous peritonitis and, 606
 —with urine from tuberculosis of kidney, 212
 Gumma, bladder, 229
 —brain, 74, 79
 —breast, 171
 —forearm, bones of, 343
 —kidney, 212
 —leg, 357
 —lip, 84
 —liver, 717
 —lung, 185
 —mediastinal, 194
 —mesenteric, 607
 —new growth differentiated from, 212
 —parotid gland, 93
 —penial, 253
 —rectal, 670
 —scalp, 49
 —scapular, 331
 —shoulder, 329, 330
 —skull, 55
 —testicle, 264
 —hydrocele accompanying, 264
 —thigh, 352
 —umbilical, 583
 Gunshot fractures, 439
 Gunstock deformity, fractures of humerus and, 478
 Guyon's procedure, palpation of kidney and, 206

 "Hair-ball" in stomach, 617
 Hallus rigidus, 359
 Hallus valgus, 359
 Hamilton's ruler test, shoulder injury and, 512
 Hammer-finger, 345
 Hammer-toe, 359, 505
 Hamstring muscles, nerves to, 377
 —paralysis of, chart, 380
 Hand, affections of, 344
 —angioma of, 347
 —anthrax of, 347
 —ape, 334
 —bones of, affections of, 348
 —carbuncle of, 347
 —carcinoma of, 347
 —chondroma of, 347
 —"claw-", 372
 —club-, 343
 —cysts of, sebaceous, 347
 —deformities of, acquired, 345
 —ulnar nerve paralysis and, 372
 —edema of, breast affections and, 169
 —epithelioma of, 347
 —erysipelas of, 347
 —fibroma of, 347
 —furuncle of, 347
 —gangrene of, emphysematous, 347
 —granulomata of, 347
 Hand, lipoma of, 347
 —malformations of, congenital, 344
 —monkey-, 371
 —muscles of, median nerve paralysis involving, 370
 —musculospiral nerve paralysis involving, 368
 —nerve supply of, 365
 —ulnar nerve paralysis involving, 373
 —nerve lesions, 346
 —osteo-arthritis of, 346
 —sarcoma of, 347
 —spade-like, myxedema and, 144
 —syringomyelia and, 346
 —tenosynovitis of, 347
 —ulcers of, perforating, 346
 Harelip, 101
 Hayem-Widal's disease, 706
 Head, Chap. IV, 46
 —injury of, blood-pressure in, 52
 —concussion, compression, contusion and middle meningeal hemorrhage, differential chart of, 58-61
 —convulsions in, 50, 52
 —cranial nerves in, 52
 —eyes in, examination of, 52
 —glycosuria in, 52
 —headache in, 50
 —hemorrhage in, 51
 —history of, 50, 51, 52
 —mental condition in, 50
 —pain in, 50
 —paralysis in, 50
 —reflexes in, 52
 —respirations in, 51
 —spinal puncture in, 52
 —tinnitus aurium in, 50
 —tongue in, protrusion of, 52
 —twitching in, 50, 52
 —vomiting in, 51
 —Perthes' disease and, 350
 Headache, brain abscess and, 71
 —brain tumors and, 80
 —cerebral aneurysm and, 73
 —cerebral vascular spasm and, 74
 —genito-urinary tract affections and, 3
 —head injury and, 50
 —tobacco history in relation to, 4
 —ureteral stricture and, 217
 —venereal history and, 4
 Heart, affections of, 178
 —dextrocardia, 178
 —mitral stenosis of, 178
 —penetrating wounds of, 178
 —hemopericardium in, 178
 —wounds of, shock in, 178
 "Heart-burn," gastritis and, chronic, 616
 Heberden's nodes, hypertrophic arthritis and, 431, 432
 —rheumatic fever and, acute, 426
 Heel, policeman's, 360
 —widening of, os calcis fractures and, 504
 Hemangioma, 39, 155
 —cavernous, of liver, 716
 —cystic, in neck, 129
 —face, 85
 —liver, C. H. Peck on, 716
 —thoracic wall, 155
 Hemarthrosis, 432
 Hematemesis, abdominal injury and, 569

- Hematemesis, chart of, differential, 624-629
 — etiological, 630
 — duodenal ulcer and, 624, 626
 — esophageal carcinoma and, 204
 — esophageal injury and, 148
 — esophageal varix and, 203, 625
 — gastric carcinoma and, 623, 625, 627
 — gastric ulcer and, acute, 618, 624
 — — chronic indurated, 619, 624, 626
 — gastro-enteric tract affections and, 3
 — liver cirrhosis and, differential chart of, 625
 — stomach and, benign tumors in, 622
 — — syphilis and, 622
 — tumors of small intestine and, 637
 Hematocele, scrotal, 262
 Hematocolpos, 309
 Hematogenous infection, acute osteomyelitis caused by, 388
 Hematoma, abdominal wall, 580
 — axillary, 158
 — ossifying, 400, 401
 — scalp, 48
 — scrotal, 262
 — subacromial bursæ, 327
 — subdeltoid bursæ, 327, 328
 — subdural, chronic, skull fracture complicated by, 447
 — superiosteal, bone cyst complicating, 397
 — thigh, 352
 Hematometra, 302
 — amenorrhea in, 301
 — cervical stenosis accompanied by, 305
 — hematocolpos causing, 309
 — imperforate hymen is, 302
 — infected, peritonitis caused by, 302
 Hematosalpinx, 295, 296
 — cervical stenosis accompanied by, 305
 Hematuria, bladder calculus and, 228
 — bladder carcinoma and, 231
 — bladder tuberculosis and, 229
 — bladder tumors and, 230
 — bladder varix and, 228
 — "bleeding kidney" and, 213
 — chart of, differential, 266-269
 — etiological, 265, 270
 — genito-urinary tract affections and, 3
 — kidney infarct and, 212
 — kidney tuberculosis and, 212
 — kidney tumors and, 215
 — prostatic carcinoma and, 238
 — prostatic hypertrophy following frequent catheterization and, 237
 — prostatic sarcoma and, 238
 — prostatic tuberculosis and, 236
 — prostatitis and, chronic, 236
 — renal aneurysm and, 213
 — ureteral calculus and, 217
 — ureteral stricture and, 217
 — ureteral tumors and, 218
 — urethral calculus and, 257
 — urethral tuberculosis and, 258
 — urethral tumors and, 257
 Hemiambyopia, occipital lobe and, lesions of, 77
 Hemianopsia, hydrocephalus and, 70
 — occipital lobe and, lesions of, 77
 — optic thalamus and, lesions of, 78
 Hemichromatopsia, occipital lobe and, lesions of, 77
 Hemimelus, 338
 Hemiplegia, acute encephalitis and, 70
 — caudate nucleus and, lesions of, 78
 — optic thalamus and, lesions of, 78
 Hemoglobin, 739
 Hemoglobinuria, epidemic. *See* Winckel's disease.
 Hemopericardium, penetrating wounds of heart and, 178
 Hemophiliacs, coagulation time in, 740
 Hemoptysis, abdominal injury and, 569
 — chart, differential, 190, 191
 — etiological, 192
 — lung injury and, 147
 — respiratory tract affections and, 3
 Hemorrhage, abdominal injury and, 569
 — cerebral, 62, 72
 — — lumbar puncture in cases of, 62
 — ear, skull fractures and, 446
 — gastric ulcer and, superficial, 618
 — head injury and, 51
 — into joint injuries, 423
 — into ovarian cyst, 292
 — into ovary, 287
 — intradural, skull fractures and, 446
 — meningeal, 62
 — — skull fracture and, 446
 — — unconsciousness in, 446
 — mouth, skull fractures and, 446
 — nose, nose fractures and, 448
 — — skull fractures and, 446
 — postpartum, presence of uterine myomata and, J. O. Polak on, 298
 — — superinvolution of uterus caused by, 303
 — stomach, foreign bodies and, 617
 — subdural, 62
 — tubal pregnancy and, 296
 — uterine, 300
 — venous sinus, skull fractures and, 446
 Hemorrhagic cyst, ovarian, 291
 — — J. A. Sampson on, 291
 Hemorrhagic diathesis, chloroma and, 156
 Hemorrhoids, 671
 — cysts of broad ligaments causing, 293
 — ovarian cysts causing, 291
 — uterine prolapse and, 298
 Hemothorax, 147, 186
 Henoch's arthritis, 428
 Hepatic artery, aneurysm of, 718
 Hepatic congestion signs, alcoholic history and, 4
 Hepatic duct, calculus of, 729
 — obstruction of, 729
 Hepatic fever, intermittent, Charcot's, 728
 Hepatoptosis, 713
 Heredity, etiologic factor in affections, 12
 — osteogenesis imperfecta and, 351
 Hereditary syphilis, 430
 Hermaphroditis, 309
 Hernia, Chap. XVI, 584
 — anatomic varieties of, 596
 — bladder, 228
 — brain, 69
 — — acquired, 69
 — chart of, anatomic, 584, 585
 — diaphragmatic, 591
 — enterocele, 596
 — entero-epiplocele, definition of, 596
 — epigastric, 591, 620, 628 insert 1

- Hernia, epiplocele, 596
 — etiology of, 585
 — extraparietal, 588
 — femoral, 588, 597
 — hydrocele differentiated from, 263
 — incarcerated, 595
 — incisional, 590
 — inflamed, 595
 — inguinal, acquired, 587
 — complete, 586
 — congenital, 587
 — direct, 587
 — extraparietal, 588
 — incomplete, 586
 — indirect, 586
 — interparietal, 588
 — interstitial, 588
 — intraparietal, 588
 — oblique, 586
 — supravescical, external, 587
 — internal, 587
 — internal, 593
 — interstitial, 588
 — intraparietal, 588
 — irreducible, 594
 — large intestine, 594
 — liver, 713
 — lung, 593
 — lumbar, 590
 — muscle, 543, 593
 — arm, 334, 342
 — leg, 351, 355
 — oblique, 586
 — obturator, 591
 — omental, 611
 — ovarian, 286, 289
 — perineal, 592
 — pudendal, 592
 — pulmonary, 148, 153
 — reducible, symptoms of, 594
 — sciatic, 592
 — scrotal enlargement caused by, 264
 — strangulated, 595
 — supravescical, 587
 — testis, 594
 — umbilical, 583, 589
 — uterine, 303
 — vaginal, 307, 592
 — varieties of, anatomic, 585, 596
 — clinical, 585, 594
 — regional, 584, 585
 — ventral, 590
 Hernia cerebri, 592
 Herpes, lip, 99, 100
 — penis, 252
 Herpes facialis, trigeminal nerve injury and, 65
 Herpes ophthalmicus, trigeminal nerve injury and, 65
 Herpes zoster, *facing* 721
 Herpetic ulcer, 35
 Heuyer and Leveuf, on dysentery, 661
 Hiccough, spontaneous rupture of esophagus and, 203
 Hickey, P. M., on radiographic measurements of femur, 494
 Hip joint, abscess of, pyogenic, 350
 — affections of, 349
 — Charcot's disease of, 350
 — dislocations of, 521-523
 — Hip joint, dislocations of, congenital, 422
 — joint, Nélaton's line in, 422
 — gout in, 350
 — inflammations of, 350
 — injuries of, 349
 — lipoma of, 350
 — malformations of, congenital, 349
 — osteo-arthritis of, 350
 — Perthes' disease and, 350
 — tuberculosis of, 350, 429, 597, 653
 Hirschberg and Pinzsohn, on tubal pregnancy, 296
 Hirschsprung's disease, 659, 684
 History, alcoholic, forming of, 4
 — auscultation in, 1, 7
 — forming of. *See* region affected.
 — general, main subjective facts of, 2, 3
 — inspection in, facts for "general record," 4
 — interpretation of, age, 9, 10, 11
 — heredity, 12
 — marital history, 11
 — nativity, 11
 — occupation, 11
 — sex, 11, 12
 — laboratory data in, 7, 8, 9
 — marital, as etiologic factor in affections, 11
 — palpation in, 1, 4
 — percussion in, 1, 6
 — questioning in, 1, 2
 — tobacco, forming of, 4
 — venereal, forming of, 4
 Hoarseness, early sign of malignant condition of thyroid gland, 138
 — goiter and, 137
 — mediastinal affections and, 193
 "Hobnail" liver, 717
 Hodgkin's disease, 162, 195, 336, 608
 — blood-picture in, 132
 — lymph gland enlargement in, 539, 540, 541
 Hollow foot, 358
 Homonymous hemianopsia, occipital lobe and, lesions of, 77
 Horner's syndrome, 79, 456
 Horns of penis, 254
 Horseshoe kidney, 209
 Hour-glass stomach, 630
 Housemaid's knee, 354, 550
 Howard, W. P., on fractures of coronoid process, 482
 — radiographic measurements in fracture of femur, 494
 Humerus, affections of, 337
 — carcinoma of, 338
 — dislocation of, anterior, Fig. 30, 513
 — exostoses of, 338
 — fractures of, 465
 — granulomata of, 337
 — inflammations of, 337
 — osteoma of, 338
 — sarcoma of, 338
 — syphilis of, 337
 — tumors of, 338
 Hump-back, 411, 414, 665
 Hunner, on ureteral stricture, 217, 273
 Hutchinson's teeth, 22
 Hydatid cyst, liver, 716
 — muscles, 544
 — neck, 142
 — thyroid, 142

- Hydatid cyst, vaginal, 308
 Hydatidiform mole, chorio-epithelioma caused by, 301
 Hydrocele, 260-264
 — labium majus, 311
 — ovarian, 289
 — — Bland Sutton on, 289
 Hydrocephalus, 53, 69, 70
 Hydronephrosis, 214
 Hydrops, gall-bladder, 721
 — intermittent, knee joint, 432
 Hydrosalpinx, 295, 296
 — N. J. Eastman on, 296
 Hydrothorax, 186
 Hydro-ureter, 217
 Hygroma, 548
 — rice-body of shoulder. *See* Subdeltoid bursa, tuberculosis of.
 Hymen, imperforate, hematocolpos caused by, 309
 — hematometra associated with, 302
 Hyoid bone, fractures of, 452
 Hypochondriasis, leading to stricture of esophagus, 201
 — sexual, in relation to bladder, prostate and seminal vesicle affections, 224
 Hyperesthesia of scalp, 49
 Hyperglycemia, pancreatitis and, acute, 691
 Hypernephroma, 215, 724
 Hyperostosis, 396
 Hyperplasia, benign, axillary, 161
 — lymph gland, 130, 336, 539, 540
 — superior maxilla, 115
 Hyperthyroidism, 138
 Hypertrophic arthritis, 431, 432
 Hypertrophy, bone, 386
 — brain, 70
 — breast, 172
 — cervix, 304
 — endometrium, 303
 — fingers, 345
 — lymph glands, 539, 540
 — muscles, 546
 — penis, 249
 — prostate, 237
 Hypoglossal nerve, injury of, 66
 Hypoleukocytosis, 739. *See also* Leukopenia.
 Hypophysis, 68
 Hypospadias, 248
 Hypothyroidism, 138, 143
 Hysterical contractures of joints, 437
 Hysterocele, 303

 Tetanus neonatorum, 731
 Idiopathic epilepsy, 75
 Ileocecal tuberculosis, 636
 Ileum, obstruction of, 685
 Ileus, adynamic. *See* Ileus, paralytic.
 — dynamic. *See* Ileus, mechanical.
 — mechanical, 677
 — paralytic, 677
 Iliac artery, aneurysm of, 665
 Iliacus muscle, nerve supply of, 374
 — paralysis of, 382
 Ilium, fractures of, 491
 Impacted fractures, 440
 Impaction, fecal, 664
 Impulse on coughing, herniæ and, 262
 Incarcerated hernia, 595
 Incisional hernia, 590

 Incontinence of urine, *See* Enuresis.
 Indirect inguinal hernia, 586
 Infantile paralysis, congenital dislocation of shoulder differentiated from, 324
 — joints in, 433
 Infantile scurvy, 393
 Infantile tuberculosis of penis, 253
 Infantile umbilical hernia, 589
 Infantile uterus, 297
 Infarct, kidney, 212
 — lung, 187
 — spleen, 703
 Infections, Chap. II, 13
 — *Bacillus œdematis*, 20
 — *Bacillus pestis*, 20
 — generalized, 14
 — gonococcus, 20
 — granulomatous, 22
 — actinomycosis, 23
 — — blastomycosis, 23
 — — glanders, 24
 — — leprosy, 23
 — — syphilis, 23
 — tuberculosis, 22
 — localized, 13
 — parasitic, 13, 24
 — pneumococcus, surgical conditions and, 18
 — specific, 16
 — staphylococcus, 19
 — streptococcus, 19
 — venereal, 20
 — Welch's bacillus, 19
 Inferior gluteal nerve, 375
 Inferior maxilla, fractures of, 450
 Inferior poliоencephalitis, 71
 — cranial nerves in, 71
 Inflation of stomach, diagnosis of pancreatic cysts and, 699
 Infracted fractures, 440
 Infrapinatus, nerve supply of, 365
 Inguinal bubo, accompanying chancreoid, 22
 Inguinal glands, bladder carcinoma and, 231
 — removal of, elephantiasis caused by, 356
 Inguinal hernia, 586, 587
 Inguinal nodes, affections of, 352
 Inguinal region, bulging of, hernia causing, 264
 — swelling in, differential chart of, 598
 Inguinal swelling, percussion of, 7
 Injury. *See* under part affected.
 Inoculation, guinea-pig, bladder tuberculosis and, 229
 — — kidney affections and, 208
 Inspection, abdominal, 553
 — case history taking and, 1
 — general examination and, 4
 — head injury and, 51
 Instrumentation, bladder, prostate and seminal vesicle affections and, 221
 — epididymitis and, acute, 261
 — genito-urinary tract affections and, 3
 — kidney affections and, 208
 — orchitis and, acute, 261
 — scrotal edema and, 261
 — urinary extravasation and, 261
 — venereal history and, 4
 Insufflation, fallopian tube, 296
 Intercondylar fracture, of elbow, 476
 Intercostal nerve, pain in, aortic aneurysm and, 195

- Intercoastal neuralgia, *facing* 721
 Intercoastal spaces, bulging of, pericarditis with effusion and, 178
 Intercourse, interference with, tumors of vulva causing, 310
 — time of last, venereal history and, 4
 Intermittent claudication, 360
 Intermittent hydrops, 432
 Internal hernia, 593
 Internal hydrocephalus, 69
 Internal plantar nerve, 375
 Internal popliteal nerve, 377
 Interosseous nerve, posterior, 365
 Intestinal obstruction, 649, 654; Chap. XXI, 677; 694, *facing* 721, 683
 — acute, 678, 679, 683, 684
 — chronic, 684, 686
 — mechanical, etiologic chart of, 681, 682
 — partial, 628 insert 1, 722
 Intestines, anthrax of, 16
 — large, Chap. XX, 658
 — — actinomycosis of, 661
 — adenoma of, 663
 — affections of, 658
 — — angioma of, 663
 — — carcinoma of, 663
 — — congenital malformations of, 659
 — — diverticulitis of, 662
 — — dysentery and, 660
 — — fibroma of, 663
 — — granulomata of, 661
 — — hernia of, 594
 — — inflammations of, 659
 — — injuries of, 659
 — — lipoma of, 663
 — — myomata of, 663
 — — obstruction of, chronic, 685
 — — tuberculoma of, 661, 662
 — — tumors of, 663, 666
 — — volvulus of, 663
 — rupture of, 572
 — small, affections of, Chap. XVIII, 632
 — — enteritis of, 633
 — — enteroptosis of, 634
 — — fecal concretions in, 632
 — — foreign bodies in, 632
 — — Glenard's disease and, 634
 — — granulomata of, 636
 — — inflammations of, 633
 — — obstruction of, chronic, 633, 685
 — — tuberculosis of, 636
 — — tumors of, 637
 — — ulcer of, typhoid, perforating, 634
 Intussusception, 682, 683
 Inversion of uterus, 299
 Irreducible hernia, 594
 Ischiorectal abscess, 669
 Israel's method, palpation of kidney by, 206
 Ivy poisoning, edema of penis caused by, 248, 250

 Jacksonian epilepsy, 75, 81
 Jaundice, Chap. XXIII, 730
 — abdominal signs in, differential chart of, 736
 — — bile-duct and, carcinoma of, 730
 — — catarrhal, 726, 727
 — — cholangitis and, acute suppurative, 727
 — — cholecystitis and, acute purulent, 719
 — — common bile-duct obstruction and, 728
 — Jaundice, esophageal varix and, 629
 — — examination in, 730
 — — gall-bladder calculi and, 721
 — — gastritis and, phlegmonous, 615
 — — gastro-enteric tract affections and, 3
 — — history of, 730
 — — — interpretation of, 731-734
 — — liver cirrhosis and, 717
 — — pancreas and, carcinoma of, 699
 — — pancreatic cysts and, 699
 — — pancreatitis and, chronic, 698
 — — stools in, "clay-colored," 733, 734
 — — types of, 731
 Jaw, actinomycosis of, 111
 — affections of, 109
 — carcinoma of, 113
 — chondroma of, 111
 — epulis of, 112
 — fibroma of, 111
 — granulomata of, 111
 — history of, 109
 — infection of, 110
 — leontiasis of, 115
 — lipoma of, 112
 — locked, 423
 — lower, dislocations of, 506, 507
 — lumpy, actinomycosis and, 111
 — myxoma of, 112
 — myxosarcoma of, 112
 — necrosis of, phosphorus causing, occupation in relation to, 110
 — odontoma of, 114
 — osteoma of, 112
 — osteomyelitis of, acute pyogenic, 110
 — phosphorous necrosis of, 110
 — sarcoma of, 113
 — superior maxilla of, hyperplasia of, 115
 — syphilis of, 111
 — tuberculosis of, 111
 — tumors of, 111
 Jejunum, obstruction of, 685
 Jewish method of circumcision, tuberculosis of penis and, 246
 Jews, Russian, thrombo-angiitis obliterans in, 356
 Joints, Chap. XI, 418
 — acromioclavicular, 331, 332
 — acute rheumatic fever and, 426
 — affections of, 331
 — — examination in, 422
 — — history of, 419, 421
 — — — interpretation of, 420
 — ankle, 430
 — arthralgia in, 424
 — arthritis of, 425, 427, 428
 — — acute, 435, 437
 — — atrophic, 431
 — — Henoch's purpura with, 428
 — — hypertrophic, 431
 — — neuropathic, 433
 — — osteo-, 434, 436
 — — pneumococcic, 428
 — — typhoidal, 428
 — — villous, 432
 — arthritis deformans of, 431
 — Baker's cysts of, 436
 — cartilage of, floating, 434, 436
 — — subluxation of, 424, 434, 436
 — — cerebrospinal fever and, 428
 — — Charcot's, 430, 433

- Joints, congenital deformities of, 418, 422, 423
- congenital dislocations of, 422
 - contractures of, hysteria causing, 437
 - dislocations of, 418, 424
 - elbow, 338, 339, 430
 - fractures of. *See* chapter on fractures.
 - gonorrhea of, 431
 - gout in, 426
 - hand and finger, 349
 - hemarthrosis in, 432
 - hemorrhage into, malignancy and, 433
 - — scurvy and, 433
 - hip, lipoma of, 350
 - — tuberculosis of, 429
 - inflammations of, 418, 419
 - injuries of, 418, 423
 - intermittent hydrops and, 432
 - "joint-mice," 424
 - knee, 424, 429
 - lipoma arborescens of, 436
 - loose bodies in, 423
 - Madelung's deformity of wrist, 424
 - paralysis and, infantile, 433
 - percussion of, 7
 - purpura rheumatica and, 428
 - rheumatic fever and, 434, 436
 - rheumatism and, acute articular, 425
 - "rice-bodies" in, 424
 - Schönlein's disease and, 428
 - sensation in, peripheral nerve injury and, 362
 - shoulder, 332, 333
 - spondylolisthesis and, 424
 - sprain of, 434, 436
 - sternoclavicular, 331, 332
 - Still's disease and, 431
 - subluxated cartilage in, 423
 - synovitis and, 423, 425
 - — chronic serous, 427, 432
 - — traumatic, differential chart of, 434, 436
 - syphilis and, 430, 435, 437
 - syringomyelia and, 433
 - tuberculosis of, 435, 437
 - tumors of, 419, 436
 - wounds of, penetrating, 423
 - wrist, injuries of, 343
- Jones, Fiske, on pancreatic inflammations, 688, 689, 711
- Jones, Sir R., on median nerve paralysis, 370
- Judd, on chronic catarrhal cholecystitis, 719
- on pancreatic inflammations, 688, 711
- Judd and Mann, on pancreatic inflammations, 711
- Kahler's disease, 404, 405. *See also* Myeloma, multiple.
- Kahn precipitation test, 740
- Kaufmann and Koenig, classification of sarcomata of parotid gland, 93
- Keen, on sarcoma of esophagus, 204
- Keloid, 39
- face, 85
 - shoulder, 329
- Keratoses of penis, 252
- Kidney, abscess of, 210
- actinomycosis of, 212
 - adenoma of, 215
 - affections of, 205
 - — regional chart of, 205
- Kidney, affections of, history of, 207
- — lumbar pain caused by, differential chart of, 274-277
 - — phenolphthalein test in, 208
 - anatomic position of, 206
 - angioma of, 215
 - bilharzia in, 215
 - "bleeding," 213
 - calculus in, 213
 - carcinoma of, 215
 - circulatory disorders of, 212
 - congenital anomalies of, 209
 - congenital displacement of, 209
 - congestion of, 212
 - cysts of, 214
 - — pararenal, 215
 - disorder of, Pasteau's point in, 206
 - *Distoma hæmatobium* in. *See* Kidney, bilharzia in.
 - endothelioma of, 215
 - *Eustrongylus gigas* disease of, 215
 - examination of, 206
 - fibroma of, 215
 - *Filaria sanguinis hominis* disease of, 215
 - floating, 213
 - *granulomata* of, 211
 - gumma of, 212
 - horseshoe, 209
 - hydronephrosis of, 214
 - hypernephroma of, 215
 - infarct of, 212
 - infection of, calculus complicated by, 214
 - inflammatory conditions of, 210
 - injuries of, 574. *See also* Abdominal injury.
 - lipoma, 215
 - movable, 213
 - myoma of, 215
 - palpation of, 206
 - — Glenard's procedure in, 206
 - — Guyon's procedure in, 206
 - — Israel's method of, 206
 - papilloma of, 215
 - parasitic affections of, 215
 - pedicle of, torsion of, *facing* 721
 - perinephritic abscess of, 211
 - polycystic, 215
 - pyelitis of, 210
 - pyelonephritis of, 210
 - pyonephrosis of, 210
 - rhabdomyoma of, 215
 - sarcoma of, 215
 - surgical, 210
 - tuberculosis of, 211
 - tumors of, 215
- Kinesthetic sense in peripheral nerve injury, 362
- King, on tumors of large intestine, 664
- Klumpke's paralysis, 346, 364
- Knee, bursæ of, diseases of, 354
- congenital dislocations of, 422
 - congenital malformations of, 352
 - housemaid's, 354, 550
 - injuries of, 354
 - Osgood-Schlatter's disease of, 392
 - pain in, flat feet and, 358
 - prepatellar bursitis of, 354
 - rugby, 392
- Knee joint, arthralgia of, 425
- cartilage subluxation of, 424

- Knee joint, Charcot's joint of, 430
 —contusion of, 353
 —dislocations, 523
 —effusion of, 353, 500
 —foreign body in, 353
 —fractures of, 500
 —inflammation of, 353
 —injuries to, 353
 —intermittent hydrops and, 432
 —sprain of, 353
 —tuberculosis of, 429
 —tumors of, 436
 Kobelt's tubules, cysts of, 293
 Koenig and Kaufman, on classification of sarcomata of parotid gland, 93
 Köhler's disease of bone, 391, 392
 Kolodny (Codman) classification of bone tumors, 404, 405
 Konig's osteochondritis dissecans, 391, 393
 Kraurosis vulvæ, 311
 Krumbhaar, on Banti's disease, 705
 Krumbhaar and Pearce, on spleen abscess, 702
 Küster's classification of bladder tumors, 218
 Kyphosis, 415
 —osteitis cystica fibrosa and, 398
 —Pott's disease and, 416

 Labium majus, hydrocele of, 311
 Labor, difficulty in, uterine myomata and, 299
 —rupture of uterus during, 298
 Laboratory data, case history taking and, 2, 7-9
 Lacrimal glands, von Mikulicz's disease and, 84, 133
 Laryngeal difficulties, tobacco history and, 4
 Lateral sinus, thrombosis of, 63
 Latissimus dorsi muscle, nerve supply of, *facial* 365
 —rupture of, 146
 Lead poisoning, 628, insert 2
 Leg, bayonet, 501
 —bed-sore of, 357
 —congenital malformations of, 355
 —contusions of, 355
 —edema of, cysts of broad ligaments causing, 293
 —elephantiasis of, 356
 —fracture of, compound, emphysematous gangrene caused by, 356
 ————emphysematous, gangrene caused by, 356
 —gangrene of, diabetic, 356
 ———emphysematous, 356
 —fractures of femur complicated by, 498
 —frost-bite followed by, 356
 —pressure causing, 357
 —Raynaud's symmetric, 356
 —thrombo-angiitis obliterans followed by, 356
 —traumatic, 356
 —gumma of, cutaneous, 357
 —injuries to, 355
 —lower, fractures of, 500
 —lupus of, 356, 357
 —milk-, 352
 —muscles of, affections of, 355
 —nerve supply of, 374, 375
 —peroneal nerve paralysis involving, 380

 Leg, muscles of, tibial nerve paralysis involving, 378
 —musculocutaneous nerve of, 374
 —plantar fascia of, rupture of, 355
 —quadriceps extensor tendon of, 355
 —sciatic pain in, 352
 —skin avulsion of, 355
 —soft parts of, elephantiasis of, 356
 ———embolism of, 356
 ———gangrene of, 356
 —inflammation of, 356
 —thrombosis of, 356
 —tuberculosis of, 356
 —trophic disturbances preceding thrombo-angiitis obliterans of, gangrene and, 356
 —tumors of soft parts of, 357
 —ulcers of, 357
 —wounds of, 355
 Leiomyoma, 39
 —sarcomatous degeneration of, 40, 300
 Leishmaniasis, 24
 —Delhi boil in, 24
 —splenic form of, 24
 Leontiasis, jaw, 115
 Leprosy, anesthetic form of, 23
 —face, 83
 —granulomatous infection of, 22
 —tongue, 106
 —tuberculous form of, 23
 Lethargic encephalitis. *See* Acute encephalitis.
 Leukemia, lymphatic, 132, 162, 336, 709
 —lymph-gland enlargement in, 539, 540
 Leukemic spleen, 707
 Leukocytes, 738, 739
 Leukocytosis, 738
 Leukopenia, 739
 Leukoplakia of tongue, 106, 107
 Leukorrhea, cervical polypi and, 304
 —endocervicitis and, 302
 —subinvolution of uterus and, 303
 —uterine displacements and, 298
 —uterine prolapse and, 298
 —vaginitis and, 308
 Levator scapuli, nerve supply of, 365
 Leveuf and Heuyer, on dysentery, 661
 Lewin, on Paget's disease, 397
 Lewin differential, osteitis deformans from osteomalacia and, 397
 Lewis, on ovarian hemorrhage, 287
 Ligament, broad, affections of, 293
 —ovarian, affections of, 293
 —round, affections of, 292, 294
 —tumors of, inguinal region swelling caused by, 598
 —uterosacral, adenomyoma of, 292
 —*See also* under specific joint.
 Ligamentum patellæ, detachment of, 354
 Light, translucency to, hydrocele and, 263
 Line, Nélaton's, Fig. 21, 493, 495
 —hip dislocation and, 422
 Linea alba, congenital malformation of, hernia in, 586
 "Lionlike" deformity, 115
 Lip, abscess of, 99
 —adenoma of, 99
 —affections of, chart of, differential, 99
 ———regional, 98
 —angioma of, 99

- Lip, anthrax of, 99
 —cysts of, 99
 —epithelioma of, 99
 —glanders of, 99, 100
 —granulomata of, 99
 —gumma of, 84
 —hare-, 101
 —herpes of, 99, 100
 —inflammation of, acute, 99
 —lymphangioma of, 99
 —papilloma of, 99
 —syphilis of, 84, 99, 100
 —chancere in, 84
 —gumma in, 84
 —secondary stage of, 84
 —tuberculosis of, 99, 100
 —tumors of, 99
 —ulcers of, 98
 Lipoma, 40
 —abdominal wall, 581
 —brain, 79
 —breast, 173
 —broad ligament, 293
 —elbow region, 339, 340
 —esophageal, 204
 —face, 85
 —fallopian tube, 296
 —forearm, soft parts of, 342
 —hand and fingers, 347
 —hip joint, 350
 —large intestine, 663
 —jaw, 112
 —kidney, 215
 —lung, 187
 —mesentery, 608
 —omentum, 611
 —parotid gland, 93
 —penis, 254
 —rectum and anus, 675
 —shoulder, 329
 —small intestine, 637
 —stomach, 622
 —tendons, 549
 —testicle, 264
 —thigh, soft parts of, 352
 —thoracic wall, 154
 —tongue, 107
 —umbilical, 583
 —vulval, 310
 —wrist, soft tissues of, 344
 Lipoma arborescens, 549
 Lipomatosis, multiple, 40
 Little's disease, 69
 Liver, Chap. XXIII, 712
 —abscess of, 715
 —multiple, 714
 —affections of, anatomic chart of, 712
 —aneurysm of, hepatic artery, 718
 —carcinoma of, 716
 —carcinoma of stomach and, 629
 —change in position of, 185
 —cirrhosis of, 625-629, 717
 —signs in, alcoholic history and, 4
 —congestion in, chronic passive, 716
 —acute, *facing* 721
 —cysts of, 716
 —examination of, 712, 713
 —Mathieu's procedure in, 713
 —granulomata of, 717
 —hemangioma of, 716
 Liver, hernia of, 713
 —hobnail, 717
 —hyperemia of, passive, 628 insert 1, 722
 —infections of, 713
 —abscess in, 715
 —injuries of, 572, 713
 —malformations of, 713
 —metastasis to, hypernephroma, 215
 —uterine chorio-epithelioma, 301
 —pancreatitis and, chronic, 698
 —ptosis of, 722, 723
 —pylephlebitis and, suppurative, 714
 —rupture of, 573
 —splenomegaly and, 705
 —transposition of, 713
 —tumors of, 716
 Localization, cerebral, 76
 Localized infections, 13
 Locked jaw, 423
 Locomotor ataxia. *See* Tabes dorsalis.
 Loin, edema of, kidney affections and, 208
 Loose bodies, 423
 Lordosis, 415
 Ludwig's angina, 121, 122
 "Lumbago," 543
 Lumbar hernia, 590
 Lumbar pain, kidney affections causing, differential chart of, 274-277
 Lumbar plexus of nerves, 374
 Lumbar puncture, cerebral hemorrhage and, 62
 Lumbar region, sinus in, actinomycosis of
 kidney and, 212
 —tuberculosis and, 212
 —tuberculous abscess in, 212
 Lumbosacral pain, subinvolution of uterus and, 302
 Lumpy jaw, actinomycosis and, 111
 Lungs, abscess of. *See* Pulmonary abscess.
 —actinomycosis of, 185
 —angioma of, 187
 —anthrax of, 16, 184
 —blastomycosis of, 185
 —bronchiectasis of, 184
 —carcinoma of, 187
 —chondroma of, 187
 —cysts of, 187
 —endothelioma of, 187
 —fibroma of, 187
 —gangrene of, 184
 —glanders of, 185
 —gumma of, 185
 —hernia of, 148, 153, 593
 —infarct of, 187
 —endocarditis and, 187
 —postoperative, 187
 —pyemia and, 187
 —injury of, 147
 —hemothorax in, 147
 —pneumohemothorax, in injury of, 147
 —lipoma of, 187
 —metastasis to, hypernephroma, 215
 —uterine chorio-epithelioma, 301
 —mycoses of, 185
 —myxoma of, 187
 —osteoma of, 187
 —pleuræ and, affections of, 178, 179
 —differential chart of, 188, 189
 —foreign bodies of, 182
 —history of, 179, 180

- Lungs, pleuræ and, history of, interpretation of, 180
- inflammatory conditions of, 182
 - tuberculosis of, 185
 - pneumonia and, 184
 - sarcoma of, 187
 - syphilis of, 185
 - tumors of, 187, 190, 191
- Lupus, arm and, 335
- "butterfly" appearance in, 83
 - face and, 83
 - leg and, 356,
 - scalp and, secondary extension, 49
- Lupus erythematosum, penis and, 255
- Lymph glands, actinomycosis of, 133, 337
- affections of, 536
 - differential chart of, 539, 540, 541
 - blastomycosis of, 133, 539
 - carcinoma of, 133, 337
 - metastatic, 539
 - cervical, 130-133
 - cubital, 336, 337
 - enlargement of, 132, 536, 539
 - affections of, 536
 - femoral region swelling caused by, 597
 - history of, 536
 - interpretation of, 536
 - Hodgkin's disease and, 539, 540, 541
 - hyperplasia and, 539, 540, 541
 - hypertrophy and, 539, 540
 - leukemia and, lymphatic, 539, 540
 - malignant disease and, 540, 541
 - syphilis and, 539, 541
 - tuberculosis and, 539, 541
 - epitrochlear, syphilis and, 337
 - examination of, 538
 - glandular fever and, 539
 - Hodgkin's disease and, 132, 336
 - hyperplasia of, 130, 336
 - inflammation of, 336
 - lymphatic leukemia of, 132, 336
 - lymphoblastoma of, 133
 - lymphoma of, malignant, 133, 539
 - lymphosarcoma of, 337
 - sarcoma of, 133
 - metastatic, 539
 - syphilis and, 132, 337
 - tuberculosis and, 337
 - von Mikulicz's disease and, 133
- Lymphadenitis, acute, 534
- abscess in, 534
 - mesenteric nodes in, 608
 - axillary, acute pyogenic, 159
 - chronic, 159
 - tuberculous, 160
 - acute, 159
- Lymphadenoma, pancreatic, 699
- stomach, 622
- Lymphangioma, 40
- cystic, neck, 129
 - parotid gland, 96
 - lip, 99
 - thoracic wall, 156
- Lymphangitis, acute, 534
- secondary abscess in, 534
 - arm and, 335
 - chronic, 534
 - thigh and, 351
 - tuberculous, forearm and, 342
 - tubular, 534
- Lymphatic cysts, breast, 172
- Lymphatic inflammation, elephantiasis of leg caused by, 356
- Lymphatic leukemia, acute, axilla in, 162
- blood in, 132
 - cervical lymph glands in, 132
 - chronic, axilla in, 162
 - cubital lymph glands in, 336
 - lymph gland enlargement in, 538, 540
- Lymphatic obstruction, 535
- Lymphatics, affections of, Chap. XIII, 533
- elephantiasis of, 535
 - granulomata of, 535
 - inflammatory conditions of, 534
 - acute lymphadenitis, 534
 - acute lymphangitis, 534
 - chronic lymphangitis, 534
 - injury to, 534
 - spina ventosa and, 535
 - syphilis and, 535
 - tuberculosis of, 535
- Lymphedema, 535
- Lymph-nodes, retroperitoneal, affections of, 612
- Lymphoblastoma, cervical lymph gland, 133
- small intestine, 637, 638
- Lymphoma, malignant, 43, 133
- lymph glands in, 539
 - typical, 40
- Lymphosarcoma, 44
- cubital lymph gland, 337
 - neck. *See* Sarcoma.
- MacCarty, W. C., on strawberry gall-bladder, 719
- McCrae, on pancreatic inflammations, 689, 711
- Macroductyly, 345
- Macroglossia, 105
- Madelung's fat neck, 40, 127. *See also* Multiple lipomatosis.
- Madelung's deformity of wrist, 345, 424
- Madura foot, 24. *See also* Mycetoma.
- "Main en griffe," 372
- "Main-en-trident" of Marie, 393
- Malar bone, fracture of, 447
- Malarial spleen, 704
- Malformations, congenital, ankle joint, 357
- brain, 68
 - fallopian tube, 294
 - fingers, 344
 - foot and toes, 358
 - forearm, 341
 - gall-bladder, 719
 - hip joint, 349
 - knee joint, 352
 - large intestines, 659
 - leg, 355
 - liver, 713
 - omentum, 610
 - rectum and anus, 668
 - shoulder, 324
 - skull, 53
 - thigh, 350
 - uterine, 297
 - effect of, sterility and, 297
 - vaginal of, 305
 - vulval, 309
 - absence, 309
 - hermaphroditism, 309

- Malformations, congenital, wrist joint, 343
 Malgaigne, double fracture of, 491
 Malgaigne's luxation of radius, 517
 Mallet-finger, 346
 Mandelbaum and Brill, on Gaucher's disease, 706
 Mankoff's sign, examination of vertebral column and, 408
 Manus vara, 343. *See also* Club-hand.
 Marble bone, 395
 Marital history, breast affections and, 165
 Marmorknochen, 395
 Martin and Williams, on dysentery, 661
 Masturbation, bladder, prostate and seminal vesicle affections and, 221
 — prostaticorrhea caused by, 236
 — venereal history and, 4
 Mathieu's procedure, examination and, 713
 Maxilla, inferior, fractures of, 450
 — superior, fractures of, 449
 — hyperplasia of, 115
 Mayo, on diverticulitis of large intestines, 662
 Meckel's diverticulum, acute intestinal obstruction caused by, 684
 Median nerve, 365
 — injury of, 334
 — paralysis of, 369
 Mediastinal involvement, Hodgkin's disease and, 162
 Mediastinal tumors, pressure on phrenic nerve of, 198
 Mediastinopericarditis, adhesive (Pick's disease), 194
 Mediastinum, abscess of, 193, 194
 — actinomycosis of, 194
 — affections of, 192
 — — regional chart of, 192
 — aneurysm of, 195
 — diseases of, differential chart of, 196, 197
 — granulomata of, 194
 — gumma of, 194
 — Hodgkin's disease of, 195
 — inflammatory affections of, 193, 194
 — retrosternal goiter and, 195
 — syphilis of, 194
 — tuberculosis of, 194
 — tumors of, 198
 Medulla, affections of, 79
 — — cranial nerves in, 79
 — tumors of, 80
 Melanotic sarcoma, 44
 Melena, duodenal ulcer and, 628
 — esophageal varix and, 629
 — gastric carcinoma and, 629
 — gastric ulcer and, acute, 628
 — — chronic indurated, 628
 — history of acute abdominal conditions and, 558
 — intestinal obstruction and, acute, 678
 — intussusception and, 682
 — liver cirrhosis and, 629
 — stomach carcinoma and, 629
 — tumors of small intestine and, 637
 Meningeal hemorrhage, 62
 — skull fracture and, 446
 Meninges, actinomycosis of, 75
 — affections of, regional chart of, 67
 Meningitis, chronic, syphilitic origin of, 74
 — skull fractures and, 446
 Meningocele, 54
 — false, 47
 — neck and, 129
 Meningococcus, affections caused by, 28
 Meningo-encephalitis, syphilitic origin of, 74
 Menorrhagia, cervical polypi and, 304
 — cysts causing, broad ligament, 293
 — inflammatory condition with, ovarian, 287
 — laceration of cervix and, 304
 — uterine displacements and, 298
 — uterine prolapse and, 298
 Menstrual disorders, ovarian tumors and, 291
 Menstrual flow, prolonged, uterine myomata and, 299
 Menstrual history, breast affections and, 165
 Menstrual periods, frequent, acute salpingitis and, 295
 — pain during acute salpingitis and, 295
 — — intensification of, 287
 — pain prior to, ovarian inflammatory conditions and, 286
 — prolonged, acute salpingitis and, 295
 Menstruation, endocervicitis and, 301
 — vascular changes in thyroid and, 135
 Mercurial ulcer, 35
 Mesenteric nodes, acute lymphadenitis of, 608
 Mesentery, affections of, 607
 — granulomata of, 607
 — Hodgkin's disease and, 608
 — inflammatory conditions of, 607
 — tear of, 576
 — thrombosis of, 608, *facing* 628
 — tumors of, 608
 Metabolism, changes in, exophthalmic goiter and, 140
 Metacarpal bones, fractures of, 488, 489
 Metacarpophalangeal joints, dislocations of, 520
 Metatarsal bones, fractures of, 504
 Metatarsalgia, anterior, 359
 Meteorism, 605
 — abdominal enlargement caused by, differential chart of, 605
 Metritis, chronic, 303. *See also* Uterus, subinvolution of, chronic.
 Metrorrhagia, inflammatory conditions with, ovarian, 287
 — laceration of cervix and, 304
 — subinvolution of uterus and, 302
 Microcephaly, 54, 68
 Microorganisms, chart of conditions caused by, 25, 26, 27, 28, 29
 Middle meningeal hemorrhage, differential chart of, 58-61
 Milk-leg, 352, 533
 Miller, C. J., on endocervicitis, 302
 Miner's elbow, 336
 Miosis, 456
 Mitchell's classification of osteomyelitis in children, 389
 Mitral stenosis, 178
 Mixed cell tumors, 45
 Mixed tumors, face, 90
 — neck, 142
 — parotid gland, 93
 — salivary gland, 44
 — testicle, 45
 Moench, on pancreatic inflammations, 688, 711
 Mole, hydatidiform, chorio-epithelioma caused by, 301

- Mole, pigmented, sarcomatous change in, 163
- thoracic wall, 155
- Molluscum contagiosum of penis, 252
- Monkey hand, 371
- Monobrachia, 333
- Moebius's sign, exophthalmic goiter and, 140
- Morton's neuralgia, 359
- Morvan's disease, 433
- Mosenthal test meal, kidney affections and, 208
- Motor area, brain, 76
- Mouth, affections of, regional chart of, 101
 - angioma of, 103
 - carcinoma of, 103
 - cleft-palate, 101
 - congenital deformities of, 101
 - dermoid cyst of, 103
 - fetor oris of, 102
 - fibroma of, 103
 - floor involvement of, Ludwig's angina and, 121
 - granulomata of, 103
 - harelip, 101
 - hemorrhage from, skull fractures and, 446
 - inflammatory conditions of, 101
 - mucocele of, 103
 - ranula of, 103
 - sarcoma of, 103
 - stomatitis of, acute catarrhal, 101
 - acute erysipelalous, 102
 - acute gangrenous, 102. *See also* Noma.
 - acute ulcerative, 102
 - chronic catarrhal, 102
 - thrush, 103
 - thyroglossal cyst of, 103
 - tuberculosis of, 103
 - tumors of, 103
 - ulcers of, 103
 - Vincent's angina of, 102
- Movable kidney, 213
- Moynihan, on Banti's disease, 705
- Mucocele of mouth, 103
- Multiple neuritis, signs of, alcoholic history and, 4
- Mummification, 30
- Mumps, 92
 - acute epididymitis and, 261
 - acute orchitis and, 92, 261
 - hydrocele and, 262
 - ovarian inflammatory conditions caused by, 92, 286
- Muscles, 335
 - abscess of, 543
 - adductor longus, ossification of, 355
 - rupture of, 351
 - affections of, Chap. XIII, 542
 - angioma of, 335, 546
 - arm, affections of, 334, 335, 336
 - atrophy of, 545
 - contusions of, 542
 - coracobrachialis, rupture of, 325
 - deltoid, ossification of, 330
 - rupture of, 325
 - desmoid tumor of, 546
 - fibroma of, 546
 - forearm, affections of, 341, 342
 - granulomata of, 543
 - hernia of, 543, 593
 - Muscles, hydatid cyst of, 544
 - hypertrophy of, 546
 - inflammatory conditions of, 543
 - injuries of, 542
 - knee, injury to, 354
 - lacerations of, 542
 - latissimus dorsi, 365
 - rupture of, 146
 - "lumbago" and, 543
 - leg, affections of, 355
 - lower limb, anterior, nerve supply of, anatomic chart of, 374
 - posterior, nerve supply of, anatomic chart of, 375
 - myositis ossificans of, 335, 544
 - nerve supply of. *See* under specific muscle.
 - paralysis of. *See* under specific muscle.
 - parasitic affections of, 544
 - pectoral, rupture of, 146
 - pectoralis major, rupture of, 325
 - pectoralis minor, rupture of, 325
 - rupture of, 542
 - abdominal wall, 571
 - biceps, 334
 - coracobrachialis, 334
 - sarcoma of, 546
 - sartorius, rupture of, 351
 - serratus, rupture of, 146, 326
 - shoulder, incised wounds of, 325
 - spasm of, 545
 - sprain of, abdominal wall, 571
 - sternomastoid, spasm of, wry-neck and, 127
 - subscapularis, rupture of, 325
 - teres major, rupture of, 325
 - trapezius, rupture of, 326
 - trichinosis of, 544
 - thigh, hernia of, 351
 - thoracic wall, rupture of, 146
 - *Trichina spiralis* in, 544
 - tumors of, 546
 - upper limb, anterior, nerve supply of, anatomic chart of, facing 365
 - posterior, nerve supply of, anatomic chart of, 365
- Muscular dystrophy, pseudohypertrophic, vertebral column in, 416
- Musculocutaneous nerve, facing 365
 - leg, 374
 - paralysis of, 366
 - muscles involved in, anatomic chart of, 367
- Musculospiral nerve, 365
 - paralysis of, 367
 - muscles involved in, anatomic chart of, 368
 - wrist-drop in, 367, 368
- Mycetoma or Madura foot, 24
- Mycoses of lung, 185
- Myeloma, 43, 405
 - Bence-Jones protein in, 43
 - bone, 384
 - multiple, 404, 405
 - skull, 56
 - spontaneous fractures and, 156
 - thoracic wall, 156
- Myers, on chemistry of blood, 741
- Myocardial insufficiency, 628 insert 1
- Myofibroma. *See* Fibroma.

- Myofibrosis. *See* Chronic subinvolution of uterus, 303.
- Myoma, 39
 —kidney, 215
 —large intestine, 663
 —ovarian, 290
 —small intestine, 637
 —stomach, 622
 —ureteral, 218
 —uterine, 299
 ———abortion in, 299
 ———bladder, irritability in, 299
 ———difficulty in labor in, 299
 ———dystocia in, 299
 ———menstrual flow prolonged in, 299
 ———rectal irritability in, 299
 —vulval, 310
 —*See also* Myofibroma.
- Myositis, 543
 —acute, muscles of upper arm and, 335
 —infective, 543
 —simple, 543
- Myositis fibrosa, sequel of Volkmann's ischemic contracture, 346
- Myositis ossificans, 544
 —congenital type of, 545
 —muscles of upper arm and, 335
- Myxedema, 144
 —spadelike hand in, 144
- Myxoid cystoma, ovarian, 291
- Myxoma, 40
 —bladder, 230, 231
 —brain, 79
 —breast, 173
 —face, 85
 —jaw, 112
 —lung, 187
 —parotid gland, 93
 —periductal, breast, 173
 —rectum and anus, 675
 —umbilical, 583
 —ureteral, 218
 —vulval, 310
- Myxosarcoma, jaw, 112
- Nail, finger, inflammation about, 348
 —toe-, affections of, 360
- Nasal bones, fractures of, 448
- Nativity as etiologic factor in affections, 11
- Nausea, brain tumor and, 80
 —gastro-enteric tract affections and, 3
- Neck, Chap. V, 116
 —abscess of, 119
 —adenitis of, cervical, acute, 119
 ———chronic, 125
 ———salivary, acute, 120
 —affections of, history of, 117
 ———interpretation of, 117
 ———regional chart of, 116
 —aneurysm of, 127
 —branchial cyst of, 128
 —carbuncle of, 120
 —carcinoma of, 133, 142
 ———branchiogenic, 133
 ———epithelioma, 133
 —cellulitis of, acute deep, 119
 ———acute superficial, 119
 —cystic hemangioma of, 129
 —cysts of, differential chart of, 130, 131
 —dermoid, 128, 142
- Neck, cysts of, echinococcus, 129
 —endothelioma of, 142
 —fistula of, congenital, 126
 ———branchial cleft, 126
 ———thyroglossal duct, 126
 —front of, infections of, etiologic chart of, 125
 —furuncle of, 120
 —granulomata of, 128
 —Hodgkin's disease of, 132
 —hydatid cyst of, 142
 —infections of, Fig. 1, 124
 —inflammatory conditions of, acute, 119
 ———differential diagnosis of, 122, 124, 125
 ———chronic, 125
 ———etiologic chart of, 123
 —lymph glands of, hyperplasia of, 130
 —lymphosarcoma of. *See* Sarcoma.
 —Madelung's disease of, 40, 127
 —meningocele of, 129
 —osteochondro-adenomata of, 142
 —osteochondrosarcoma of, 142
 —perithelioma of, 142
 —rib, cervical, 126
 —salivary adenitis, chronic, 125
 —sarcoma of, 142
 —sebaceous cyst of, 127
 —sinus in, 126
 —swelling of, esophageal diverticulum and, 202
 —teratoma of, 141
 —thyroglossal cyst of, 128
 —thyroids in, accessory, 141
 —tuberculosis of lymph glands of, 130
 —tumors of, cystic, 128
 ———mixed, 142
 —woody phlegmon of, 125
 —wry-, 127
- Necrosis, bone, 383, 389
 —fat, 600
 —jaw, phosphorus causing, occupation in relation to, 110
 —leg, Raynaud's symmetric gangrene and, 356
 —phosphorus, jaw, 110
 —rectum and anus, 674
 —skull, 55
- Nélaton's line, Fig. 21, 493; 495
 —hip dislocation and, 422
- Neoplasms. *See* Tumors.
- Nephritis signs, alcoholic history and, 4
- Nephrolithiasis. *See* Kidney, calculus of.
- Nephroptosis. *See* Kidney, movable.
- Nerve, abducens, injury of, 65
 —anterior crural, 374
 ———paralysis of, 381, 382
 —anterior thoracic, *facing* 365
 —arm, injuries of, 334
 —atrophy of, optic, traumatic asphyxia and, 148
 —cervical, 5, 6, 7, 8, *facing* 365
 —circumflex, *facing* 365
 ———paralysis of, 366
 —cranial, head injury and, 52
 —injuries of, 63-65
 ———manifestations of, skull fractures and, 445
 —external popliteal, paralysis of, 379
 —great sciatic, paralysis of, 377
 —inferior gluteal, 375

- Nerve, inferior gluteal, paralysis of, 381
 —injuries of, anesthesia in, types of, 362
 —interosseous, posterior, 365
 —lesions of, foot deformities caused by, 359
 ——hand, 346
 —lesser sciatic, paralysis of, 381
 —lumbar plexus, 374
 —median, *facing* 365
 ——injury of, 334
 ——paralysis of, 369
 ———muscles involved in, anatomic chart of, 370
 ———sensory loss in, 370
 —musculocutaneous, *facing* 365
 ——leg, 374
 ——paralysis of, 366
 ———muscles involved in, anatomic chart of, 367
 —musculospiral, *facing* 365
 ——paralysis of, 367-369
 ———wrist-drop in, 367, 368
 —obturator, 374
 ——paralysis of, 382
 ———sciatic, 375
 —oculomotor, injury of, 63
 —olfactory, injury of, 63
 —optic, injury of, 63
 —paralysis of, anatomic chart of. *See* under specific nerve.
 —peripheral, Chap. X, 361
 —peroneal, paralysis of, 379, 380
 —phrenic, pressure on, mediastinal tumors and, 198
 —plantar, 375
 —posterior interosseous, *facing* 365
 —posterior thoracic, paralysis of, 366
 —sacral plexus, 375
 —scapular, 365
 —sciatic, tenderness of, sciatica and, 352
 —subscapular, *facing* 365
 —superior gluteal, 374
 ——paralysis of, 380
 —suprascapular, 365
 ——paralysis of, 366
 —thigh, affections of, 352
 —thoracic, 1, *facing* 365
 ——posterior, *facing* 365
 —tibial, 375
 ——paralysis of, 377, 378
 —trauma of, paralytic ileus caused by, 677
 —trigeminal, injury of, 64
 —trochlear, injury of, 64
 —ulnar, *facing* 365
 ——injury of, 335
 ——paralysis of, 372, 373
 Neuralgia, brachial, subclavian aneurysm and, 127
 —cervical rib causing, 126
 —intercostal, *facing* 721
 —Morton's, 359
 —plantar, 359
 —scalp, 49
 —spermatic cord, tuberculous epidymitis and, 264
 —trigeminal nerve injury with, 65
 Neuritis, arm, 336
 —brachial plexus paralysis caused by, 364
 —multiple, signs of, alcoholic history and, 4
 —optic, brain abscess and, 71
 Neurofibroma, upper arm, 335
 Neuroglioma ganglionare, 79
 Neuroma, 40
 —amputation, 40
 —arm, 336
 —penis, 254
 —shoulder, 330
 —thoracic wall, 155
 —vulva, 310
 Neuropathic arthritis, 433
 —shoulder, 332
 —sternoclavicular joint, 332
 Nevus, abdominal wall, 581
 —penis, 254
 —shoulder, 329
 Newell, L. C., on tubal patency tests, 297
 Night-sweats, respiratory tract affections and, 3
 Nipple, breast affections and, 168
 —diseases of, 176
 —Paget's disease of, 176
 —syphilis of. *See* Syphilis, breast.
 Nitrogen, non-protein, 741
 Nocardia, pulmonary affections and, 191
 Nocardiosis, 25
 Nodes, Heberden's hypertrophic arthritis and, 431, 432
 ——rheumatism and, articular, acute, 426
 —Parrot's, bone syphilis and, 391
 Noma, 32, 102
 —epidemics and, 82
 —face, 82
 —institutions and, 82
 —toxemia and, 82
 —ulceration and, 82
 —umbilical, 582
 Nose, fractures of, hemorrhage in, 448
 —hemorrhage from, skull fractures and, 446
 Nosebleeds, repeated, superior longitudinal sinus thrombosis and, 63
 Nucleus, caudate. *See* Caudate nucleus.
 Nystagmus, cerebellar affections and, 79
 —hydrocephalus and, 70
 Obstruction, bile-duct, 729
 —common, 728
 —cecal, chronic, 685
 —colon, chronic, 686
 —hepatic duct, 729
 —ileum, 685
 —intestinal, 649, 654, 677, 694, 695, *facing* 721
 ——acute, 678
 ——chronic, 684
 ———large intestine, 685
 ———small intestine, 685
 ——partial, 628 insert 1
 —small intestine, gall-stones causing, 633
 —jejunum, 685
 —lymphatic, 535
 —pyloric, foreign bodies causing, 617
 ——gastric ulcer and, acute, 619
 ———chronic indurated, 619
 ——stomach benign tumors and, 622
 ——stomach carcinoma and, 623
 ——stomach sarcoma, 630
 —sigmoid, chronic, 686
 Obturator externus muscle, nerve supply of, 374
 —paralysis of, 382

- Obturator hernia, 591
 Obturator nerve, 374
 — paralysis of, 382
 — muscles involved in, anatomic chart of, 382
 Obturator-sciatic nerve, 375
 Occipital lobe, brain, 78
 Occiput, dislocation of, on atlas, 507
 Occupation, actinomycosis and, 82
 — anthrax and, 84, 184
 — as etiologic factor in affections, 11
 — bladder affections and, 221
 — glanders and, 84
 — — pulmonary, 185
 — kidney calculi and, 213
 Ockerblad, N. F., ureteral stricture, reference, 273
 Oculomotor nerve, injury of, 63
 — polioccephalitis and, superior, 70
 Odontoma, hard, 115
 — jaw, 114
 Olecranon bursa, inflammation of, 336
 — tuberculosis of, 336
 Olecranon process, fractures of, 480
 Olfactory nerve, injury of, 63
 Omentum, affections of, 610, 612
 — bands of, 610
 — congenital malformations of, 610
 — cysts of, 611
 — hernia of, 611
 — inflammation of, 610
 — injuries of, 610
 — torsion of, 611, 628 insert 2, 649
 — tumors of, 611
 Omphalomesenteric duct, 606
 — acute intestinal obstruction caused by, 684
 — patent, 583
 Oöphoritis, 286
 Ophthalmoscopic examination, tobacco history and, 4
 Opie, on pancreatic inflammations, 688, 711
 Optic atrophy, hydrocephalus and, 70
 Optic nerve, atrophy of, traumatic asphyxia and, 148
 — injury of, 63
 Optic neuritis, brain abscess and, 71
 Optic thalamus, accompanying fever, hemianopsia with, 78
 Orbital notches, palpation of, head injury and, 52
 Orchitis, acute, acute infectious diseases and, 260
 — instrumentation and, 261
 — mumps and, 92, 261
 — urethral calculus complicated by, 257
 Oris, fetor, 102
 Os calcis, epiphysitis of, 392
 — fractures of, 503; Fig. 29, 503
 — tearing away of portion of, 355
 Os magnum, dislocations of, 519
 — fractures of, 487
 Osgood-Schlatter's disease, 391, 392
 Ossificans, myositis, 544
 Ossification, muscle, 330, 334, 342, 355
 — tendon, 548
 Ossifying carcinosis, von Recklinghausen's, 238
 Ossifying hematoma, 400, 401
 Osteitis, acute, 409
 — chronic, 410
 Osteitis deformans, 397. *See also* Paget's disease.
 Osteitis fibrosa cystica, 398
 Osteo-arthritis, chronic, 410
 — hand, 346
 — hip, 350, 597
 Osteochondritis, 384, 391
 Osteochondritis deformans juvenilis, 391
 Osteochondritis dissecans of Konig, 391, 393
 Osteochondritis syphilitica, 393
 Osteochondro-adenomata of neck, 142
 Osteochondrosarcoma of neck, 142
 Osteodystrophia cystica, 393
 Osteogenesis imperfecta, 351, 395
 Osteogenic sarcoma, 400, 401
 Osteoma, 41, 399
 — brain, 79
 — cancellous, 41
 — face, 85
 — humerus, 338
 — infection accompanying, 112
 — ivory, 41
 — jaw, 112
 — lung, 187
 — scapula, 331
 — shoulder, 330
 — skull, 55
 — thoracic wall, 156
 — tongue, 107
 — traumatic, upper arm, 335
 Osteomalacia, 395, 397, 416
 Osteomyelitis, 409
 — acute, 387, 388, 409
 — bone necrosis in, 389
 — children and, 389
 — chronic, 388, 410
 — fractures causing, 387
 — humerus, 337
 — jaw, acute pyogenic, 110
 — scapula, 330
 — sclerosing non-suppurative (Garre), 389
 — subacute, 358
 — typhoid, acute, 151
 Osteoperiostitis in bone syphilis, 390
 Osteopsathyrosis, 395
 Osteosclerosis fragilis generalisata, 395
 Otitis media, sinus thrombosis caused by, 74
 Ovarian ligament, affections of, 9, 293
 Ovariocele, 289
 Ovary, abscess of, 286
 — actinomycosis of, 289
 — adenoma of, 290, 291
 — affections of, 286
 — apoplexy of, 287
 — congenital malformations of, 286
 — cysts of, 290, 291, 292
 — dermoids of, 290, 291
 — fibroma of, 290
 — granulomata of, 289
 — hemorrhage of, 287, 292
 — hemorrhagic cysts of, 291
 — hernia of, 289
 — hydrocele of, 289
 — inflammations of, 286, 287
 — injury of, 286
 — myoma of, 290
 — papillary cysts of, 291
 — pregnancy and, 287
 — prolapse of, 288
 — sarcoma extending to uterus, 300

Ovary, thyroids in, accessory, 141

— tuberculosis of, 289

— tumors of, 290, 291

Pachydermatocele of shoulder, 330

Paget's disease, bone and, 397

— nipple and, 176

Pain, acute, abdominal quadrants and, 232-233, 559-563, 620-621, 648-653, 663, 694-697, 703, 721

— aneurysm and, 213, 665, 708

— appendicitis and, 641, 648, 654, 721, 722

— back, 271-273, 278-281, 304

— Banti's disease and, 708

— bladder and prostate and seminal vesicle, 3, 213, 224-225, 227-231, 236, 238, 240-241

— bone and, affections of, 386-388, 390, 392, 411, 429, 652, 665

— breast affections and, 166

— cardiospasm and, 614

— chronic, abdominal quadrants and, 242-243, 563-566, *facing* 628, 664-665, 708-711, 722, 725

— coronary thrombosis and, 194

— esophagus and, affections of, 200, 203, 625

— eyeball, sarcoma suggested by, 90

— female genital organs and, 295, 298, 309, 652, 694

— flat feet and, 358

— intestinal obstruction and, 649, 678, 683-684, 694, 722

— intestines and, affections of, 3, 633-634, 637, 648, 664-666, 696-697, 708

— jaundice and, differential chart of, 735

— kidney and, affections of, 208, 210, 212-213, 215, 648

— leukemia and, 709

— liver and gall-bladder, affections of, biliary ducts and, 625, 696, 719-722, 727

— mesenteric tear and, 696

— omental torsion and, 649

— pancreas and, affections of, 690, 693-694, 698-699

— peritonitis and, acute, 696

— rectum and, affections of, 669-670, 675, 676

— respiratory tract affections and, 3

— spleen and, affections of, 702, 708, 709

— stomach and, affections of, 615-619, 622-625, 630

— typhoid ulcer and, 635, 649

— ureter and, affections of, 217, 218, 652

— urethral, 657

Palmar fascia, Dupuytren's contracture of, 345

Palpation, abdominal, facts ascertained by, 5, 554

— case history taking and, 1

— head injury and, 52

— methods of, general, 4

— rectal, facts ascertained by, 6

— thoracic, facts ascertained by, 5

— tumor, facts ascertained by, 5

— vaginal, facts ascertained by, 5

Palsy, birth, Erb's, 423

— cerebral, childhood, 69

— cranial nerve, hydrocephalus and, 70

— eye muscle, hydrocephalus and, 70

— facial, brain tumor and, 81

— — facial nerve injury and, 66

Palsy, facial, optic thalamus lesions and, 78

— nerve, wry-neck and, 127

Pancreas, abscess of, 693

— affections of, Chap. XXII, 687

— — chart of, regional, 687

— calculi of, 698

— carcinoma of, 699

— cysts of, 605, 698, 999

— examination of, 687

— — Desjardins' pancreatic point in, 687

— granulomata of, 698

— inflammations of, 688, 711

— injury of abdominal wall, 572

— tumors of, 699

Pancreatitis, acute, 688-693, 694-695

— chronic, 4, 628 insert 1, 693, 698, 724

Papilloma, 41

— abdominal wall, 581

— bladder, 230, 231

— brain, 79

— esophageal, 204

— face, 85

— fallopian tube, 296

— kidney, 215

— lip, 99

— malignant degeneration in, 107

— penis, 254

— rectum and anus, 675

— shoulder, 329

— small intestine, 637

— thoracic wall, 154

— tongue, 107

— umbilical, 583

— ureteral, 218

— urethral, 257

— vaginal, 309

Papillary cystadenoma, breast, 173

Papillary synovitis, shoulder, 333

Paralysis, brain tumor and, 81

— cerebral hemorrhage and, 72

— crossed, affections of pons and, 79

— Erb-Duchenne, 22, 364

— facial, malignant tumor of parotid gland and, 96

— head injury and, 50

— infantile joints in, 433

— — leading to pes equinus, 359

— Klumpke, 346, 364

— muscle. *See* muscle affected.— nerve. *See* nerve affected.

— spastic, 351

Paralytic ileus, 677, 678

Paraphimosis, penis and, 249

Parasites, biliary ducts, 728

Parasitic affections, 24

— kidney and, 214, 215

— muscles and, 544

Parasitic cysts, lung, 187

— tongue, 107

Parathyroid glands, 141

Parathyroid tumors, 142

Parietal lobe, brain, 78

Paronychia, 348. *See also* Finger nail.

Parotid gland, abscess of, 92

— actinomycosis of, 92

— affections of, 91

— — chart of, differential, 94-97

— — — regional, 91

— calculus in, 97

— cysts of, 96, 97

- Parotid gland, fibrosis of, chronic, 92
 — fistula of, 97
 — granulomata of, 92
 — gumma of, 93
 — inflammation of, 91, 92
 — — acute epidemic. *See* Mumps.
 — sclerosis of, 93
 — syphilis of, 93
 — tuberculosis of, 93
 — tumors of, 93, 96
 — von Mikulicz's disease of, 84, 133
 Parotitis, 91
 Parrot's nodes, bone syphilis and, 391
 Pasteau's point, kidney disorder and, 206
 Patella, absence of, 352
 — dislocations of, 524
 — — congenital, 422
 — — outward, Fig. 35, 524
 — fractures of, 499; Fig. 26, 499
 Patella ligament, detachment of, 354
 Pearce and Krumbhaar, on splenic abscess, 702
 Pearce, Krumbhaar and Frazier on wandering spleen, 705
 Peck, C. H., on hemangioma of liver, 716
 Pectineus muscle, paralysis of, 382
 — nerve supply of, 374
 Pectoral muscles, rupture of, 146
 Pectoralis major muscle, nerve supply of, *facing* 365
 — rupture of, 325
 Pectoralis minor muscle, nerve supply of, *facing* 365
 — rupture of, 325
 Pedicle. *See* Torsion.
 Pelvis, connective tissue of, suppuration of, 294
 — dislocations of, 520, 521
 — fractures of, 490-492
 — inflammatory disease of, acute, 628 insert 2
 Penile fistula, urethro-, 258
 Penis, affections of, 248-255
 — chancroid of, 250
 — epispadias of, 248
 — hypospadias of, 248
 — inflammatory conditions of, 249
 — injuries of, 248
 — syphilis of, 252, 253
 — tumors of, 254, 255
 — urethra and, affections of, chart of, regional, 244, 245
 — — history of, 246
 Percussion, auscultatory, 6
 — case history taking and, 1
 — methods of, general, 6
 Perforating typhoid ulcer, 634
 Perforating ulcer, 34
 Periarteritis, 528
 Pericarditis with effusion, 178
 Pericardium, penetrating wounds of, 178
 Perigastric abscess, 616
 Perineal fistula, 225, 240, 258
 Perineal hernia, 592
 Perineal sinus, 227
 Perinephritic abscess, 211
 Periostitis, acute infective, 387
 — acute traumatic, 386
 — chronic, 388
 — scurvy and, infantile, 393
 Peripheral nerve injuries, Chap. X, 361
 — examination for, 361
 — joint sensation in, 362
 — kinesthetic sense in, 362
 — reaction in, degeneration, 363
 — — electrical, 363
 — — faradic current, 363
 — — galvanic current, 363
 — sensibility in, deep, 362
 — — epicritic cutaneous, 362
 — — protopathic cutaneous, 362
 — sensory disturbances in, determination of, 362
 — test-tube temperature tests for, 362
 — vibration sense in, 362
 — wool-cotton tests in, 362, 363
 Peristalsis, visible, 628, 677, 679
 Perithelioma, neck, 142
 Peritoneum, Chap. XVII, 599
 — affections of, 599
 — cysts of, 606
 — inflammatory conditions of, 599
 — tumors of, 606
 Peritonitis, acute, 301, 302, 492, 600, 628
 — insert 2, 677, 696-697
 — aseptic, 492, 599
 — diffuse, 601
 — pneumococcic, 602
 — tuberculous, 289, 603, 605, 606
 Periurethral abscess, 257
 Perobrachia, 333
 Peroneal artery, injuries to, 355
 Peroneal nerve paralysis, 379
 Peroneal tendons, dislocation of, 355
 Perthes' disease, 350, 391
 Pes cavus, 358
 Pes equinus, paralysis followed by, infantile, 359
 Pes planus, 358
 Peterman, M. G., on cholecystitis, 719
 Petit's triangle, perinephritic abscess and, 211
 Phagedena of penis, 251
 Phalanges, fracture of, 489, 505; Fig. 19, 489
 — joints of, dislocations of, 520
 — tuberculosis of, 348
 — tumors of, 348
 Pharyngeal abscess, retro-, 122
 Pharyngitis, acute, Vincent's angina similar to, 121
 Phenolphthalein test, kidney affections and, 208
 Phimosis, acquired, 248
 — congenital, 248
 — para-, penile, 249
 Phlebitis, 532
 Phlegmasia alba dolens, 352, 353
 Phlegmon, woody, neck and, 125
 Phocomelus, 338
 Phosphorous necrosis, jaw and, 110
 Phosphorous poisoning, bone necrosis caused by, 389
 Phrenic nerve, mediastinal tumors pressing on, 198
 Pick's disease, 603. *See also* Adhesive mediastinopericarditis.
 Pilonidal cyst, 675
 Pineal gland, affections of, 68

- Pinzsohn and Hirschberg, on tubal pregnancy, 296
- Pipe, etiologic factor in production of epitheliomata, 90
- Pituitary gland, affections of, 68
- Plague, 20
- Plantar fascia, 355, 358
- Plantar neuralgia, 359
- Plantaris muscle, nerve supply of, 375
- tibial nerve paralysis and, 378
- Platelets, blood-, 740
- Pleuræ, affections of, 185
- empyema of, 183
- injury of, 147
- lungs and, affections of, 178, 179
- — differential chart of, 188, 189
- — history of, 179, 180
- — inflammatory conditions of, 182
- malignant tumors of, 190
- pleurisy of, 184, 621, *facing* 721
- tuberculosis of, 185
- Pleural cavity, affections of, Groca's paravertebral triangular area of dulness in, 186
- aspiration in, empyema and, 183
- chylothorax in, 186
- hemothorax in, 186
- hydrothorax in, 186
- pneumothorax in, 186
- pyothorax in. *See* Empyema.
- Plexus, brachial, paralysis of, 364
- Plugs, Dittrich's, bronchiectasis and, 184
- Plummer, on exophthalmic goiter, 140
- Plummer's silk thread test, esophageal diverticulum and, 128
- Pneumococcic arthritis, 428
- Pneumococcic peritonitis, 602
- Pneumococcus, as factor in septicemia, 15
- surgical affections caused by, 26
- Pneumococcus infections, surgical conditions and, 18
- Pneumohemothorax, injury of lung and, 147
- Pneumonia, abdominal symptoms in, 184
- “acute abdomen” and, 184
- interest to surgeon of, 184
- leading to empyema, 183
- postoperative, 184
- — infarct of lung and, 187
- Pneumonic form of plague, 20
- Pneumothorax, 186
- Poisoning, ivy, of penis, 248, 250
- lead, 628 insert 2
- Polak, J. O., on carcinoma of uterus, 300
- on postpartum hemorrhage in presence of uterine myomata, 298
- Policeman's heel, 360
- Polioencephalitis, inferior, 71
- superior, 70
- Pollakiuria, bladder calculus and, 227
- chronic vesiculitis and, 239
- Polydactyly, 344
- Polypi, 39
- bladder, 230
- cervical, 304
- degeneration of, myxomatous, 39
- — sarcomatous, 39
- rectum and anus, 674
- small intestine, 637
- urethral, 257
- Pons, affections of, 79
- — cranial nerves in, 79
- tumors of, 80
- Pool and Stillman, on aneurysm of splenic artery, 703, 704
- Popliteal nerve, external, 377
- internal, 377
- Popliteal space, pain in, 357
- Popliteal vessels, injury to, 354
- Popliteus muscle, nerve supply of, 375
- Porencephaly, 69
- Portal pyemia, 714
- Portal vein, inflammation of, 714
- Posthitis of penis, 250
- Postoperative atony of bladder, 226
- Postoperative paralytic ileus, 678
- Postoperative pneumonia, 184
- Posture, alteration of, perinephritic abscess and, 211
- — bladder calculus and, 228
- effect of, expectoration and, pulmonary abscess and, 183
- relief of cystocele and, 306
- Pott's disease, 411, 665
- Pott's fracture, 502, 503
- Pregnancy, abdominal enlargement in, 605
- breast affections in, 166
- cervix in, laceration of, 304
- hernia, uterine, 303
- myomata in, uterine, 299
- ovarian, 287
- pyelitis in, 210
- thyroid in, vascular changes in, 135
- tubal, 296, 652, 694, 695
- See* differential chart “Acute Abdominal Pain with Shock,” 296
- Prepatellar bursa, 354
- Prepuce, diphtheria of, 255
- See also* Phimosis.
- Presenile gangrene, 32
- Pretibial bursa, 354
- Probe, use of, diagnosis of head injuries and, 47
- Proctitis, acute, 668
- chronic, 668
- Projectile vomiting, brain abscess and, 71
- Prolapse, ovarian, 288
- rectal, 671, 683
- uterine, 298
- Proptosis, exophthalmic goiter and, 140
- Prostate, abscess of, 235
- affections of, 221, 223, 224, 234
- calculi of, 236
- congestion of, 235
- examination of, method of, 234
- history in, 220
- hyperemia of, 235
- hypertrophy of, 237
- inflammatory conditions of, 235, 236
- pain in, 224, 225
- tuberculosis of, 236
- tumors of, 237, 238
- Prostatitis, 235, 236
- Prostatorrhæa, 236
- Protopathic cutaneous sensibility, peripheral nerve injuries and, 362
- Pruritus, vulval, 310, 311
- Pruritus ani, 672
- Psammoma, 42
- Psathyrosis, idiopathic, 395

- Pseudohypertrophic muscular dystrophy, vertebral column in, 416
- Pseudoleukemia, 132
- anemia infantum and, 707
- *See also* Hodgkin's disease.
- Psoas abscess, inguinal region swelling caused by, 598
- Psoas muscle, nerve supply of, 374
- Ptoxis, cavernous sinus thrombosis, 63
- liver, 722, 723
- oculomotor nerve injury and, 64
- stomach, 617
- Puberty, vascular changes in thyroid and, 135
- Pudendal hernia, 592
- Pulled elbow, 339, 517
- Pulmonary abscess, 182, 183
- Pulmonary affections, aspergillus in, 191
- nocardia in, 191
- Pulmonary embolism, postoperative, 187
- Pulmonary glanders, 185
- Pulmonary hernia, 148, 153
- Pulmonary tuberculosis, indication for surgical pneumothorax, 185
- pneumothorax complicating, 186
- Pulmonocoele, 148. *See also* Pulmonary hernia.
- Pulsating exophthalmos, 62, 530
- Pulsation, expansile, aneurysms and, 127, 213
- goiter and, 138
- visible, exophthalmic goiter and, 135
- Pulse, cerebral hemorrhage and, 72
- gastritis and, phlegmonous, 615
- head injury and, 52
- pancreatitis and, acute, 690
- pyelphlebitis and, 715
- radial, inequality of, aortic aneurysm and, 195
- Pulse pressure, subclavian aneurysm and, 127
- Pupils, cerebral hemorrhage and, 72
- lesions of corpora quadrigemina and, 78
- oculomotor nerve injury and, 64
- Purpura rheumatica, 428
- Pustule, malignant, 16
- Pyelitis, 210, 648
- children and, 211
- Pyelography, kidney affections and, 208
- ureteral stricture and, 217
- Pyelonephritis, 210
- bladder tumors and, 230
- Pyemia, 15
- lung, infarct of, 187
- portal, 714
- Pylephlebitis, 608, 714-715
- Pyloric obstruction, gastric ulcer and, 619
- stomach and, carcinoma in, 623
- foreign bodies in, 617
- sarcoma in, 630
- tumors in, benign, 622
- Pyloric stenosis, congenital, 614
- gastric ulcer and, chronic indurated, 619
- stomach carcinoma and, 623
- Pyonephrosis, 210
- Pyosalpinx, 295
- Pyrimiformis muscle, nerve supply of, 375
- Quadrants, abdominal pain in. *See* differential and regional charts, in Contents.
- Quadratus femoris muscle, nerve supply of, 375
- Quadriceps extensor muscle, nerve supply of, 374
- paralysis of, 382
- Quadriceps extensor tendon, 354, 355
- Quadriceps femoris muscle, rupture of, 351
- Questioning, case history taking and, 1, 2
- Racemous aneurysm, 530
- Rachitis, 394
- achillobursitis in, 360
- craniotabes in, 394
- vertebral column in, 416
- Rachitic deformities of humerus, 338
- Rachitic spleen, 704
- Radial artery, aneurysm of, 343
- Radial head, fracture of, Fig. 15, 479
- Radial pulse, inequality of, aortic aneurysm and, 195
- Radiography, fractures and, 442
- intestinal obstruction and, 683, 686
- kidney affections and, 208
- Perthes' disease and, 350
- subluxation of, Malgaigne's, 517
- Radius, absence of, congenital, 341
- dislocations of, 338, 516, 517
- fractures of, 479-487
- subluxation of, Malgaigne's, 517
- Rankin, F. W., on actinomycosis of large intestines, 661
- on tuberculosis of large intestines, 662
- Ranula, mouth, 103
- tongue, 107
- Ranschoff, on gall-bladder injury, 719
- Raynaud's disease, 32, 346, 356
- Reaction of degeneration, peripheral nerve injury and, 363
- Record, general, history and inspection in, facts relating to, 4
- "Rectal shelf," signs of intestinal malignancy, 6, 683
- Rectocoele, 298, 307
- Rectovaginal fistula, 307
- Rectovaginal septum, adenomyoma of, 292
- Rectum, abscess of, 669
- actinomycosis of, 670
- anus and, Chap. XX, 666
- cysts of, pilonidal, 675
- sebaceous, 675
- diverticulum of, 673
- examination of, 235, 236, 238, 239
- fistulae of, 225, 240, 309
- foreign bodies of, 671
- granulomata of, 670
- guma of, 670
- hemorrhoids of, 671
- hysteria of, 674
- inflammations of, 668
- ischiorectal abscess of, 669
- malformations of, congenital, 668
- palpation of, facts ascertained by, 6
- proctitis of, 668
- prolapse of, 671
- pruritus ani of, 672
- sinus of, 227
- stricture of, 672
- syphilis of, 670
- tuberculosis of, 670
- tumors of, 292, 674-676
- ulceration of, 673
- Reflex, Babinski, idiopathic epilepsy and, 75

- Reflex, cutaneous, 459
 — head injury and, 152
 — tendon, 459
 Regional chart. *See* Contents.
 Regurgitation, food, esophageal dilatation and, 202
 — esophageal diverticulum and, 127, 202
 — esophageal strictures and, 202
 — esophageal tumors and, 203
 Reidel's "woody" thyroiditis, 136
 Respiratory tract affections, facts to be ascertained in, 3
 Retention, urine, 226
 — constitutional symptoms in, 256
 — prostatic hypertrophy and, 237
 Retention cyst, face, 85
 — vaginal, 308
 Retroflexion, uterine, 298
 Retromammary abscess, 169
 Retroperitoneal cyst, 725
 Retroperitoneal sarcoma, 725
 Retropharyngeal abscess, 121, 122
 Retrosternal goiter, 137, 195
 Retroversion, uterine, 298
 Retzius, space of, 576
 Reyfuss, on pancreatic inflammations, 711
 Rhabdomyoma, 41
 Rheumatism, achillobursitis in, 360
 — acute articular, 332, 425
 Rhomboideus, nerve supply of, 365
 Rib, cervical, 126, 409
 — brachial plexus paralysis in, 364
 — dislocations of, 509, 510
 — fracture of, 146, 463, 464
 "Rice-bodies," in joints, 424
 Rickets. *See* Rachitis.
 Rider's bone, 352, 355, 545
 Risus sardonius, 17
 Rivini's duct, location of, 92
 Robbins, S. A., on cystography in tumors of round ligaments, 294
 Robson, Mayo, on gall-stones in small intestine, 633
 — on stomach actinomycosis, 621
 Robson's point, 718
 Rodent ulcer, face and, 90
 — *See also* Epithelioma.
 Rotte, H., on ovarian hemorrhage, 287
 Round ligament, tumors of, 292, 294, 598
 Rubin, I. C., on tubal patency tests, 296
 Rugby knee, 392
 Rupture, abdominal wall, 576
 — bladder, 227, 575
 — intestinal, 572
 — esophageal, spontaneous, 202
 — kidney, 574
 — liver, 573
 — muscle, 146, 351, 542
 — stomach, 572
 — tendon, 547
 — urethral, 256
 — uterine, 298
 Saber tibia, 22
Saccharomyces albicans, thrush caused by, 103
 Sacral plexus of nerves, 375
 Sacralization, 409
 Sacro-iliac dislocation, 520
 Sacro-iliac strain, sciatica caused by, 352
 Sacrum, dislocations of, 568
 — fractures of, 457, 492
 Saddle-back deformity, syphilis and, 111
 Salivary gland, abscess of, 121
 — mixed tumors of, 144
 Salivation, gastro-enteric tract affections and, 3
 — increased, esophageal strictures and, 202
 — foreign bodies in esophagus and, 200
 — parotid gland affections and, 92, 93
 Salpingitis, 295, 652, 653
 Salpinx, hemato-, 295, 296
 — hydro-, 295, 296
 — pyo-, 295
 Sampson, J. A., on hemorrhagic or "chocolate" cysts of ovary, 291
 — on uterine myoma, 299
 Sampson and Brown, on tuberculosis of large intestine, 662
 Sarcoma, abdominal wall, 581
 — appendix, 650
 — bladder, 230, 231
 — bone, 405
 — brain, 79
 — breast, 173, 175
 — broad ligament, 293
 — cervical lymph glands, 133
 — chondro-, shoulder and, 330
 — epulis and, 112
 — esophageal, 201, 204
 — eyeball, 90
 — face, 90
 — fallopian tube, 296
 — giant-cell, bone cyst complicating, 397
 — hand and fingers, 347
 — humerus, 338
 — large intestine, 666
 — jaw, 112, 113
 — kidney, 215
 — liver, 716
 — lung, 187
 — lymph gland, cervical, 133
 — mesenteric, 608
 — metastatic lymph glands in, 538
 — mouth, 103
 — muscle, 546
 — myeloid, shoulder in, 330
 — neck, 142
 — omentum, 611
 — osteogenic, 400, 401
 — ovarian ligament, 293
 — pancreatic, 699
 — parotid gland, 93, 96
 — penis, 255
 — peritoneal, 606
 — phalangeal, 348
 — rectum and anus, 676
 — retroperitoneal, 725
 — prostatic, 238
 — round ligament, 294
 — skull, 56
 — small intestine, 637
 — spleen, 710
 — stomach, 630
 — tendons, 549
 — testicle, 264
 — thoracic wall, 156, 157
 — tongue, 107
 — types of, 44
 — umbilical, 584

- Sarcoma, uterine, 299-301
 — vaginal, 309
 — vertebral column, 417
 — rupture of, 351
 — vulval, 310
 Sartorius muscle, nerve supply of, 374
 — paralysis of, 382
 Scalp, abscess of, subpericranial, 48
 — affections of, 46
 — — history of, 46
 — aneurysm of, arteriovenous, 49
 — — cirroid, 49
 — carbuncle of, 48
 — cephalhematoma of, 47
 — erysipelas of, 48
 — furuncle of, 48
 — hematoma of, 48
 — hyperesthesia of, 49
 — inflammatory conditions of, 48
 — lupus of, as secondary extension, 49
 — neuralgia of, 49
 — syphilis of, 49
 — tuberculosis of, 49
 — tumors of. *See* chapter on "Tumors."
 — wounds of, 47
 Scaphoid, dislocation of, 519
 — fractures of, 504
 Scapula, affections of, 330
 — fractures of, 364, 464, 465, 513
 — granulomata of, 331
 — gumma of, 331
 — inflammatory conditions of, 330
 — tuberculosis of, 331
 — tumors of, 331
 — "winged," rupture of trapezius muscle and, 326
 Scapular nerve, 365
 Schlatter's disease. *See* Osgood-Schlatter's disease.
 Schönlein's disease, joints in, 428
 Sciatic hernia, 592
 Sciatic nerve, great, paralysis of, anatomic chart of, 377
 — lesser, paralysis of, anatomic chart of, 381
 Sciatica, 352
 Sclerosing non-suppurative osteomyelitis (Garre), 389
 Sclerosis, multiple, chronic encephalitis and, 71
 — parotid gland, 93
 Scoliosis, 414
 Scrotal enlargements, affections causing, 258
 — etiologic chart of, 259
 — history of, 260
 — — interpretation of, 260
 Scrotal fistula, 258
 Scrotal swellings, differential chart of, *fac-*
ing 264
 — percussion of, 7
 Scrotum, abscess of, 262
 — chimneysweep's cancer of, 264
 — cysts of, 264
 — disintegration of, urinary extravasation and, 261
 — eczema of, chronic, 262
 — edema of, 261, 262
 — elephantiasis of, 263
 — epithelioma of, 261, 264
 — granulomata within, 263
 — hematocele of, 262
 Scrotum, hernia in, 264
 — hydrocele in, 262
 — inflammatory conditions of, 262
 — injury of, 261
 — malignant changes in, 262
 — sinuses of, tuberculous epididymitis and, 264
 — tumors in, 264
 — varicocele in, 263
 Scudder, on epulis, 112
 — on odontomata, 114
 — on sarcoma of jaw, 114
 Scurvy, hemorrhage into joints and, 433
 — infantile, 393
 Seal baby, 338. *See also* Phocomelus.
 Sebaceous cyst, abdominal wall, 580
 — breast, 172
 — face, 85
 — forearm, soft parts of, 342
 — hand and fingers, 347
 — neck, 127
 — penis, 254
 — rectum and anus, 675
 — shoulder, 329
 — thoracic wall, 156
 — umbilical, 583
 — vulval, 310
 — wrist, 344
 Semilunar dislocation, 518
 Semimembranosus muscle, nerve supply of, 375
 — paralysis of, 380
 Seminal fluid, urethral tuberculosis and, 258
 Seminal vesicles, affections of, 218, 220, 221, 223, 224, 225, 238, 239
 — history of, 220
 — — interpretation of, 220
 — inflammatory conditions of, 238
 — tuberculosis of, 239
 — — secondary affection as, 239
 Semitendinosus muscle, nerve supply of, 375
 — paralysis of, 380
 Senile gangrene, 32
 Sensory area, brain, 76
 Sensory disturbances, determination of, peripheral nerve injuries and, 362
 — gangrene of leg and, thrombo-angiitis obliterans followed by, 356
 Sensory loss, median nerve paralysis and, 370
 — ulnar nerve paralysis and, 373
 Septicemia, 15
 — acute infective periostitis and, 387
 — acute osteomyelitis and, 388
 — phlegmasia alba dolens and, 352
 Septicemic form of plague, 20
 Septum, rectovaginal adenomyoma of, 292
 Serpiginous advancement in lupus, 83
 Serratus magnus muscle, nerve supply of, *facing* 365
 Serratus muscle, rupture of, 146, 326
 Sex, as etiologic factor in affections, 11, 12
 — fractures and, 439
 — thyroid affections and, 138
 Sexual desire, genito-urinary tract affections and, 3
 — increase of, chronic vesiculitis and tuberculous vesiculitis and, 239
 Sexual excess, bladder and, prostate and seminal vesicle affections and, 221

- Sexual hyperchondriasis, bladder and prostate and seminal vesicle affections and, 224
- Sexual perversion, prostaticorrhea caused by, 236
- Sexual power, loss of, prostaticorrhea causing, 236
- Shelf, rectal, 6
- Shipley, A. M., on gall-bladder torsion, 721
- Shock, abdominal injury and, 569
- acute uterine prolapse and, 298
- appendicitis and, acute, 648
- retrocecal, *facing* 721
- bladder and, rupture of, 227
- heart and, wounds of, 178
- hemothorax and, 186
- intestinal obstruction and, 649
- ovarian cyst torsion and, 652
- pain and, acute diffuse abdominal, differential chart of, 694-697
- pancreatitis and, acute, 690
- pregnancy and, extra-uterine, 652
- pyelitis and, acute, 648
- salpingitis and, acute, 652
- tubal pregnancy and, 296
- typhoid ulcer and, perforating, 635
- volvulus in, 683
- “Shooting” bone, 330
- Shoulder, actinomycosis of, 329
- affections of, 324
- bursæ of, affections of, 327
- clavicular, chronic inflammation of, 328
- subacromial, arthritic deposits in, 327
- hematoma of, 327
- inflammation of, 327
- subdeltoid, arthritic deposits in, 328
- hematoma of, 327, 328
- inflammation of, 327
- tuberculosis of, 328
- Charcot's disease in, 332
- congenital dislocation of, infantile paralysis differentiated from, 324
- congenital malformations of, 324
- clavicle, partial or complete absence of, 324
- contours of, Fig. 30, 513
- dislocations of, 512, 513, 514
- congenital, 422
- gumma of, 329, 330
- injuries of, 324
- Bailey's test in, 512
- Callaway's test in, 512
- Dugar's test in, 512
- Hamilton's ruler test in, 512
- joint of, ankylosis of, 333
- arthritic deformans of, 333
- articular rheumatism of, acute, 332
- dislocation of, brachial plexus paralysis caused by, 364
- flail joint, 333
- fracture of, brachial plexus paralysis caused by, 364
- granulomata of, 332
- inflammatory conditions of, 332
- neuropathic arthritis of, 332
- tuberculosis of, 332
- typhoid arthritis of, 332
- ligaments of, incised wounds of, 326
- rupture of, acromioclavicular, 326
- biceps, 326
- Shoulder, ligaments of, rupture of, coracoclavicular, 326
- coracoclavicular, 326
- muscles of, incised wounds of, 325
- rupture of, biceps, 325
- coracobrachialis, 325
- deltoid, 325
- pectoralis major, 325
- pectoralis minor, 325
- serratus anterior, 326
- subscapularis, 325
- teres major, 325
- trapezius, 325
- pachydermatocele of, 330
- papillary synovitis of, 333
- shortening of, clavicle fracture and, 462
- skin avulsion of, 324
- Sprengel's deformity of, 324
- tumors of, 329, 330
- Sigmoid, obstruction of, chronic, 686
- tumors of, 292, 663
- diverticulitis of, acute, 663
- Sigmoiditis, acute, 663
- Sign, Ballance's, 574
- Dalrymple's exophthalmic goiter and, 140
- Mannkopf's, vertebral column examination and, 408
- Moebius', exophthalmic goiter and, 140
- Stellwag's, exophthalmic goiter and, 140
- Trendelenburg's, hip dislocation and, congenital, 422
- von Graefe's, exophthalmic goiter and, 140
- “Silent” areas of brain, 446
- “Silver fork” deformity, 486
- Sinus, bone, 388, 390
- breast, 171
- cavernous, injury of, 62
- thrombosis of, 63
- cranial, thrombosis of, differential chart of, 64-65
- lateral, thrombosis of, 63
- lumbar region, 212
- neck, 126
- perineal, 227
- scrotal, tuberculous epididymitis and, 264
- rectal, 227
- superior longitudinal, thrombosis of, 63
- vaginal, 227
- venous injury of, 63
- Sinus thrombosis, 63
- Skene's glands, inflammation of, gonorrheal endometritis and, 301
- vulvitis in, 310
- Skin, avulsion of, forearm and, 341
- leg and, 355
- shoulder and, 324
- upper arm and, 334
- dermoid cysts in, 291
- dimpling of, breast affections and, 168
- flushing of, exophthalmic goiter and, 140
- metastases to, sarcoma of stomach and, 630
- penial, affections of, 252
- venereal history and, 4
- Skull, affections of, regional chart of, 53
- fractures of, 442
- base, 442
- vault, 442
- cerebral compression in, 446
- cerebral concussion in, 446

- Skull, fractures of, cerebral contusion in, 446
 — cerebral edema in, 446
 — cerebral laceration in, 446
 — complications of, 446, 447, 507
 — cranial nerve manifestations in, 445
 — deafness in, 446
 — differential diagnosis of, 447
 — ear hemorrhage in, 446
 — etiology of, 442
 — facial palsy in, 446
 — frequency of site of, 442
 — mouth, 446
 — hemorrhage in, intradural, 446
 — meningeal, 446
 — nose, 446
 — venous sinus, 446
 — mechanism of displacement in, 442
 — meningitis in, 446
 — chronic, complicating, 447
 — radiography in, 447
 — symptomatology in, 443
 — syphilis in relation to, 442
 — inflammation of, 54, 55
 — malformations of, acquired, 54
 — congenital, 53
 — murmur over, 73
 — myeloma of, 56
 — parasitic cysts of, 55
 — osteitis deformans and, 397
 — Paget's disease and, 56
 — percussion of, 7
 — syphilis of, 55, 391
 — tuberculosis of, 55
 — tumors of, 56
 "Sleeping sickness." See Acute encephalitis.
 Slesinger, on actinomycosis of cecum, 657
 — on actinomycosis of large intestines, 661
 Smell center, brain, 77
 — loss of, olfactory nerve injury and, 63
 Smoker's patch, 106
 Smoking, as etiologic factor in production of epitheliomata, 90
 Snyder, C. C., on liver abscess, 716
 Soleus muscle, nerve supply of, 375
 — tibial nerve paralysis and, 378
 Space, Retzius', 576
 — abscess of, 579
 — infection of, 579
 — involvement of, ruptured urethra and, 256
 — semilunar, Traube's, 556
 Spasm, esophageal, 203
 — muscular, 545
 — vascular, cerebral, 73
 Spasmodic torticollis, spinal accessory nerve affections and, 66
 Spastic paralysis, 351
 Spaulding, H. V., on papillary cysts of ovary, 291
 Speech, difficulty in, hypoglossal nerve affections and, 66
 — inferior poliоencephalitis and, 71
 — disorder in, cerebellar affections and, 79
 Speech centers, brain, 77
 Spermatic cord, 258, 260, 263, 264, 598
 Spina bifida, hydrocephalus and, 69
 Spina ventosa, 535
 Spinal accessory nerve, injury of, 66
 Spinal cord, affections of, bladder affections caused by, 222
 Spinal cord, compression *vs.* complete division, 458
 — disease of, sciatica differentiated from, 352
 — involvement of, vertebral fractures with, 458
 Spinal fluid, 741
 — examination of, 8, 9
 — hydrocephalus and, 70
 Spinal puncture, head injury and, 52
 Spine, 406
 — cervical, fractures of, 455
 — fractures of, 453
 — tuberculosis of, 410-412
 — typhoid. See also Vertebral column.
 Spiral fractures, 439
Spirochæta icterohæmorrhagiæ, affections caused by, 28
Spirochæta pallidum, 252
 Spleen, abscess of, 702
 — Elting, E. W., on, 702
 — Pearce and Krumbhaar on, 702
 — affections of, Chap. XXII, 70
 — regional chart of, 700, 701
 — cysts of, 707, 709
 — dislocated, 704
 — ectopic, 704
 — examination of, 701
 — gangrene of, 705
 — granulomata of, 704
 — tuberculosis, 704
 — syphilis, 704
 — Hodgkin's disease in, 132
 — inflammations of, 701, 702, 703, 708
 — injury of, 573
 — leukemia of, 707
 — malarial, 704
 — pancreas and, Chap. XXII, 687
 — position of, 701
 — rachitic, 704
 — tumors of, 709, 710
 — stomach, carcinoma of, 629
 — wandering, 704
 — Pearce, Krumbhaar and Frazier on, 705
 Splenic anemia, 705
 — Banti's syndrome in, 706
 Splenic artery, aneurysm of, 703, 704, 708
 Splenic form of leishmaniasis, 24
 Splenic infarct, 703
 — thrombosis of, 704
 Splenic vessels, embolism of, 704
 Splenomegaly, 705
 — associated with blood, bone-marrow and liver conditions, 705
 — Banti's disease, 705
 — Chauffard-Minkowski's disease, 706
 — Hayem-Widal's disease, 706
 — Gaucher's disease, 706
 — splenic anemia, 705
 — von Jaksch's anemia, 707
 Spondylitis deformans, vertebral column in, 410
 Spondylolisthesis, 424
 — vertebral column in, 416
 Sprain, differential chart of, 434-436
 — knee joint, 353
 — ankle joint, 358
 — elbow joint, 338
 Sprengel's deformity of shoulder, 324
 Sputum, actinomycosis and, lung, 185
 — anthrax and, lung, 184

- Sputum, bronchiectasis and, 184
 — echinococcus cyst and, lung, 187
 — examination of, 8
 — gangrene and, lung, 184
 — pulmonary abscess and, 183
 — pulmonary glanders and, 185
 — respiratory tract affections and, 3
 Staphylococcus, pyemia and, 15
 — septicemia and, 15
 — surgical affections caused by, 25
 Staphylococcus infection, 19
 Status lymphaticus, 537. *See also* Thymus, 193
 Steatorrhea, pancreatic affections and, 695, 698
 Stellate fractures, 439
 Stellwag's sign, exophthalmic goiter and, 140
 Stenosis, cervical, 305
 — esophageal, 200
 — mitral, 178
 — pyloric, congenital, 614
 — — gastric ulcer and, chronic indurated, 619
 — — stomach carcinoma and, 623
 — vaginal, 305
 Stenson's duct, affections of, 91, 97, 98
 — differential chart of, 94, 96, 97
 — location of, 92
 Sterility, cervical hypertrophy and, 304
 — chronic form of septic endometritis and, 301
 — chronic salpingitis and, 295
 — laceration of cervix and, 304
 — ovarian cysts and, 291
 — uterine displacements and, 298
 — uterine malformations and, 297
 — uterine superinvolution and, 303
 Sternoclavicular joint, inflammation of, acute, 331
 — — chronic, 331
 — neuropathic arthritis of, 332
 — tuberculosis of, 331
 Sternum, dislocations of, 508
 — fractures of, 147, 462, 463
 Steward and Evans, on ulnar nerve paralysis, 372
 Still's disease, 431, 432
 Stillman and Pool, on aneurysm of splenic artery, 703, 704
 Stomach, abscess of, 615
 — achlorhydria of, 616
 — achylia gastrica of, 616
 — actinomycosis of, 621
 — — Mayo Robson on, 621
 — affections of, Chap. XVIII, 613
 — — anatomic chart of, 613
 — anthrax of, 16
 — atony of, acute, 616
 — carcinoma of, 622-630
 — — cardia, 629
 — — gastric contents in, 629
 — — glandular metastasis in, 629
 — — liver in, 629
 — — pyloric obstruction in, 623
 — — spleen in, 629
 — cardiospasm of, 614
 — congenital anomalies of, 614
 — — transposition, 614
 — — pyloric stenosis, 614
 — dilatation of, acute, 616, 617, 703
 Stomach, dilatation of, abdominal enlargement caused by, 605
 — foreign bodies in, 617
 — granulomata of, 621
 — — actinomycosis, 621
 — — syphilis, 622
 — — tuberculosis, 622
 — "hair-ball" in, 617
 — horn-glass, 630
 — inflammatory conditions of, 614, 615, 616
 — inflation of, diagnosis of pancreatic cysts and, 699
 — ptosis of, 617
 — rupture of, 572
 — sarcoma of, 630
 — — metastases to skin, 630
 — syphilis of, 622
 — tuberculosis of, 622
 — tumors of, 622, *facing* 628, 630, 722, 723
 — ulcer of, acute, 618, 619, 624-628
 — — chronic, 619, *facing* 628, 722, 723
 — — perforation of, 694-697
 — — superficial, 618
 Stomach tube, inadvisable in acute gastric ulcer, 628
 Stomatitis, gangrenous. *See* Noma.
 — *See also* Mouth, inflammations of.
 Stools, appendicitis and, chronic, 723
 — blood in, bright red, gastro-enteric tract affections and, 3
 — change in color of, gastro-enteric tract affections and, 3
 — "clay-colored," jaundice and, 733, 734
 — colitis and, chronic, 664, 708
 — duodenal ulcer and, 628
 — enteritis and, acute, 633
 — — chronic, 634
 — enterocolitis and, acute, 648
 — esophageal varix and, 629
 — examination of, 8
 — gall-stones in, gall-bladder calculi and, 721
 — gastric carcinoma and, 629
 — gastric ulcer and, acute, 628
 — — chronic indurated, 628
 — gastro-enteritis and, acute, 695
 — intestinal obstruction and, 649, 684, 695, 722
 — liver cirrhosis and, 629
 — pancreas and, carcinoma of, 699
 — pancreatitis and, chronic, 698
 — "ribbon," tumors of rectum and, 676
 — shape of, gastro-enteric tract affections and, 3
 — sigmoid carcinoma and, 665
 — strangulated hernia and, 653
 — "tapeworm," tumors of rectum and, 676
 — tarry, gastro-enteric tract affections and, 3
 — tuberculosis of large intestines and, 662
 — typhoid ulcer and, 649
 Strabismus, cavernous sinus thrombosis and, 63
 Strangulated hernia, 595
 Strangulation, intestinal, intestinal obstruction caused by, 682
 Streptococcus, pyemia and, 15
 — septicemia and, 15
 — surgical affections caused by, 25
Streptococcus hæmolyticus, erysipelas caused by, 16

- Streptococcus infections, 19
 Stricture, bile-duct, 729
 — bladder and prostate and seminal vesicle affections and, 221
 — esophageal, 201
 — — acquired, 201
 — — congenital, 201
 — kidney affections and, 208
 — rectum and anus, 672
 — ureteral, 217, 273
 — urethral, 257
 — urethral history and, 4
 Struma. *See* Goiter.
 Strumitis, definition of, 135
 Subacromial bursæ, arthritic deposits in, 327
 — hematoma of, 327
 — inflammation of, 327
 Subclavian artery, aneurysm of, 127
 — — brachial plexus paralysis caused by, 364
 Subdeltoid bursæ, arthritic deposits in, 328
 — hematoma of, 328
 — inflammation of, 327
 — tuberculosis of, 328
 Subdural hemorrhage, 62
 Subinvolution, uterine, 302, 303
 Sublingual glands, von Mikulicz's disease in, 133
 Subluxation, cartilage, joints and, 423, 424
 — definition of, 506
 — Madelung's spontaneous, of wrist, 345
 Submaxillary glands, von Mikulicz's disease in, 84, 133
 — *See also* Ludwig's angina.
 Submental adenitis, acute, 122
 Submental glands, abscess of, 122
 Subphrenic abscess, *facing* 721
 — chronic, 725
 Subscapular nerve, *facing* 365
 Subscapularis muscle, nerve supply of, *facing* 365
 — rupture of, 325
 Subungual region, melanotic sarcoma in, 44
 Sugar, blood, 740
 Superinvolution, uterine, 303
 Superior gluteal nerve, 374, 375
 Superior longitudinal sinus, thrombosis of, 63
 — — edema of forehead in, 63
 — — repeated nosebleeds in, 63
 Superior polioencephalitis, 70
 Suppurative pylephlebitis, inflammatory conditions complicated by, 714
 Supracondylar fracture, femur, Fig. 25, 498
 — humerus, 474, Fig. 14, 475
 Suprapatellar bursitis, 354
 Suprapubic region, pain in, acute, bladder conditions causing, differential chart of, 232, 233
 — — chronic, differential chart of, 242, 243
 Suprascapular nerve, 365
 — paralysis of, 366
 Supraspinatus, nerve supply of, 365
 Supravescical hernia, 587
 Sutton, Bland, on hydrocele of ovary, 289
 Sutton, L. A., on ovarian pregnancy, 287
 Swallowing, difficulty in, acute submental adenitis and, 122
 — — esophageal diverticulum and, 127, 202
 — — esophageal injury and, 200
 Swallowing, difficulty in, gastro-enteric tract affections and, 3
 — — hypoglossal nerve affections and, 66
 — — inferior polioencephalitis and, 71
 — — Ludwig's angina and, 127
 — — thyroid affections and, 135
 — — tumors of esophagus and, 203
 — disturbances of medulla and, lesions of, 79
 — movements of thyroid gland during, 137
 — pain on, esophageal conditions and, 201
 — — — inflammatory, 200
 Sweats, cholangitis and, acute suppurative, 727
 — common bile-duct obstruction and, 728
 — pylephlebitis, 715
 Sweating, cutaneous, exophthalmic goiter and, 140
 Swelling, neck, esophageal diverticulum and, 202
 — femoral region, differential diagnosis of, 597
 — inguinal region, differential diagnosis of, 598
 — scrotal region, 258, 259, 263, 264
 Symphysis, fractures of, 492
 Symptomatic epilepsy, 75
 Symptoms, abdominal, pneumonia and, 184
 Syndactyly, 345
 Syndrome, Banti's, 706
 — Horner's, 456
 Synovitis, 423, 425
 — chronic serous, 432
 — contracting, hand and fingers, 347
 — crepitant, hand and fingers, 347
 — gonococcus infection complicated by, 20
 — papillary, shoulder, 333
 — traumatic, differential chart of, 434-436
 — — knee joint, 353
 Syphilis, 21
 — bladder, 229
 — bladder and prostate and seminal vesicle affections and, 221
 — bone, 390, 391
 — brain, 74
 — breast, 171
 — cervical lymph gland, 132
 — chancre of, 21
 — congenital, 22
 — elbow joint, 339
 — epitrochlear lymph gland, 337
 — Erb's paralysis accompanying, 22
 — face, 83
 — fingers, 348
 — Hutchinson's teeth, 22
 — large intestine, 662
 — jaw, 111
 — joint, Charcot's joint in, 430, 435-437
 — lip, 84, 99, 100
 — liver, 717
 — lung, 185
 — lymph gland enlargement in, 539, 541
 — lymphatics in, 535
 — mediastinum in, 194
 — muscles in, 336, 543
 — nipple in, 177
 — pancreas in, 698
 — small intestine, 636
 — testicle affections and, 260
 — penis in, 252
 — rectum and anus in, 670

- Syphilis, *saber tibia* accompanying, 22
 —scalp, 49
 —skull, 55
 —skull fractures and, 442
 —spleen in, 704
 —stomach in, 622
 —tendons in, 548
 —testicle, 264
 ——differentiation from hydrocele, 263
 —thoracic wall, 152
 —thyroid gland, 136
 —tongue, 106
 —vertebral column, 413
 —vulval, 310
 —Wassermann reaction in, 21
 Syringomyelia, hand and, 36
 —joints in, 433
 —vertebral column and, 416
- Tabes dorsalis, 628 insert 2
 —fractures caused by, 439
 Tabes mesenterica, 607
 Tachycardia, exophthalmic goiter and, 139
 Tænia, gall-bladder, 721
 ——Aviles on, 721
 Talipes arcuatus, 358
 Talipes calcaneus, 357
 Talipes equinovarus, 357
 Talipes equinus, 357
 Talipes valgus, 357
 Talipes varus, 357
 Tarsal bones, fractures of, 503
 Taste center, brain, 77
 Taste disturbance, facial nerve injury and, 66
 —glossopharyngeal nerve injury and, 66
 —olfactory nerve injury and, 63
 Teeth, dental root cysts of, 114
 —dentigerous cysts of, 114
 —Hutchinson's, 22
 —non-erupted, 114
 —odontomata, 114
 —percussion of, 7
 Telling, on diverticulitis of large intestines, 662
- Temperature, appendicitis and, acute, 648
 ——retrocecal, *facing* 721
 —cholangitis and, acute suppurative, 727
 —cholecystitis and, acute, *facing* 721
 —acute purulent, 719
 —colitis and, chronic, 664
 —common bile-duct obstruction and, 728
 —coronary thrombosis and, 694
 —cystitis and, acute, 230
 —diverticulitis and, 664
 —ectopic pregnancy and, 694
 —empyema and, 183
 —enterocolitis and, acute, 648
 —epididymitis and, 261
 —gall-bladder perforation and, 696
 —gastritis and, phlegmonous, 615
 —gastro-enteritis and, acute, 694
 —gastro-intestinal perforation and, 696
 —hernia and, strangulated, 652
 —hip tuberculosis and, 652
 —Hodgkin's disease and, acute, 162
 —intestinal obstruction and, 694
 —jaundice and, 733, 737
 —kidney affections and, 203, 210, 213
 —leukemia and, 709
 —lung and, gangrene of, 184
- Temperature, mesenteric tear and, 696
 —omental torsion and, 649
 —osteomyelitis and, 388
 —ovarian cyst torsion and, 652
 —pancreatic abscess and, 693
 —pancreatitis and, acute, 694
 —perigastric abscess and, 616
 —peritonitis and, acute, 696
 —acute infection and, 387
 —phlegmasia alba dolens and, 352
 —Pott's disease and, 665
 —pregnancy and, extra-uterine, 652
 —pyelitis and, acute, 211, 648
 —pylephlebitis and, 714
 —pyonephrosis and, 210
 —salpingitis and, acute, 295, 652
 —splenic abscess and, 702
 —splenic cysts and, 709
 —typhoid ulcer and, 649
 ——perforating, 635
 —urinary extravasation with infection and, 261
 —uterine rupture and, 298
 Temporal lobe, brain, 78
 Temporomaxillary joint, congenital locked jaw and, 423
 Tendons, affections of, Chap. XIII, 547
 —contusions of, 547
 —dislocation of, 547
 —granulomata of, 548
 —hand and fingers, 346, 347, 348
 —inflammation of, 547
 —injuries of, 547
 —leg, rupture of, 355
 —ossification of, 548
 —peroneal, dislocation of, 355
 —rupture of, 547
 —tumors of, 549
 —wounds of, 547
 —wrist, ganglion of, 344
 —tuberculosis of, 344
 Tenesmus, rectal, calculus of bladder and, 227
 —cystitis and, acute, 230
 —prostatic hypertrophy and, 237
 —rectocele and, 307
 —volvulus and, 683
 —vesical, cystitis and, acute, 230
 —calculus of bladder and, 227
 —cystocele and, 306
 Tenia, affections caused by, 28
 Tennis players, rupture of tendo achillis in, 355
 Tenosynovitis, 547. *See also* Tendons, affections of.
 Tensor fascia femoris, nerve supply of, 374
 Teratoma, neck, 141
 —testicle, 264
 —thyroid, 142
 Teres major muscle, nerve supply of, *facing* 365
 —rupture of, 325
 Testicle, affections of, 258
 —syphilis and, 260
 —congestion of, acute, 262
 —contusion of, 261
 —cysts of, 264
 ——dermoid, 264
 ——simple, 264
 —fibrocystic disease of, 264
 —gumma of, 264

- Testicle, gumma of, hydrocele accompanying, 264
 — hydrocele differentiated from, 263
 — hernia of, 594
 — history of, 260
 — interpretation of, 260
 — inflammatory conditions of, 262
 — tuberculosis of, 263
 — secondary to tuberculosis of epididymis, 263
 — tumors of, 45, 263, 264
 — undescended, inguinal region swelling caused by, 598
 — sarcoma of, 264
 Tests, cotton wool, peripheral nerve injury and, 362, 363
 — cystocele determined by, 306
 — Goetsch adrenalin, exophthalmic goiter and, 140
 — Kahn precipitation, 740
 — Mosenthal, kidney affections and, 208
 — phenolphthalein, kidney affections and, 208
 — test-tube temperatures, peripheral nerve injury and, 362
 — tubal patency, 296
 — tuberculin, 653
 — Van den Bergh, 729, 741
 — Wassermann, 740
 Tetanus, 17, 628 insert 2
 Tetanus bacillus, surgical affections caused by, 27
 Tetanus neonatorum, 17
 Thigh, affections of, 350
 — blood-vessels of, affections of, 352
 — congenital malformations of, 350
 — inflammatory conditions of, 351, 352
 — inguinal nodes of, affections of, 352
 — muscles of, affections of, 351, 352
 — nerve supply of, 374
 — nerves of, affections of, 352
 — tumors of, 352
 Thompson, L. R., on transillumination of cervix, 304
 Thoracic duct, injury of, 196, 534
 — rupture of, formation of chylothorax in, 186
 Thoracic nerve, 1, 365
 Thoracic wall, affections of, 148
 — differential chart of, 154, 155
 — abscess of, chronic pyogenic, 151
 — actinomycosis of, 152
 — aneurysm of, 152
 — "cancer en cuirasse" of, 156
 — cellulitis of, acute diffuse, 151
 — chloroma of, 156
 — contusions of, 146
 — furuncle of, 151
 — furunculosis of, acute diffuse, 151
 — hernia of, pulmonary, 153
 — history of, 149
 — interpretation of, 149
 — inflammatory conditions of, 151
 — muscles of, rupture of, 146
 — osteomyelitis of, acute pyogenic, 151
 — acute typhoid, 151
 — syphilis of, 152
 — tuberculosis of, 152
 — tumors of, 153-157
 — wounds of, 145
 Thorax, Chap. VI, 145
 — accessory thyroids in, 141
 — auscultation of, 7
 — bony, fractures of, 146
 — injury of, history of, 145
 — intrathoracic, 147
 — wall, 145
 — palpation of, facts ascertained by, 5
 — percussion of, facts ascertained through, 6
 Thrill, goiter and, colloid, 138
 — exophthalmic, 138
 — preëxisting, hemorrhage into, 135
 — vibratory, echinococcus cyst and, 129
 Thrombo-angiitis obliterans, 356, 528
 Thrombophlebitis, 532
 Thrombosis, arm, 336
 — arterial, 531
 — cerebral, 73
 — coronary, 694, 695
 — leg, 356
 — mesenteric, 608, 628 insert 2
 — splenic vessel, 704
 — thigh, 352
 — vein, 532
 — venous sinus, 74
 Thrush, 103
 Thymus gland, enlargement of, 193
 Thyroglossal duct, cyst of, 103, 128
 — fistula of, 126
 Thyroid, 134-144
 — abscess of, 120, 136
 — accessory, 141
 — parathyroid cysts of, 141
 — parathyroid tumors of, 142
 — affections of, sex and, 138
 — anatomic relations of, 137
 — bursa of, 129, 142
 — carcinoma of, in preëxisting goiter, 143
 — cartilage of, fractures of, 453
 — congenital hypertrophy of, "butterfly" shape in, 135
 — cretinism in, 143
 — cyst of, dermoid, 142
 — hydatid, 142
 — fetal adenoma of, 139
 — goiter of, 137
 — adenomatous, 138, 139
 — colloid, 138, 139
 — metastatic, 139
 — cystic, 138
 — adenomatous, 139
 — exophthalmic, 138, 139
 — parenchymatous, 138
 — simple, 139
 — retrosternal, 137
 — vascular, 135
 — granulomata of, 136
 — hemorrhage within preëxisting goiter of, 135
 — hoarseness as early sign of malignant condition of, 138
 — inflammatory conditions of, 135
 — hyperthyroidism of, 138
 — hypertrophy of, congenital, 135
 — hypothyroidism of, 138, 143
 — inflammatory conditions of, 135
 — myxedema of, 144
 — syphilis of, 136
 — teratoma of, 142

- Thyroid, thyroiditis, acute, 135
 ——"woody" of Reidel, 136
 —tuberculosis of, 137
 —tumors of, 142
 —vascular changes in, 135
 —menstruation and, 135
 —pregnancy and, 135
 —puberty and, 135
 Tibia, congenital dislocation of, 352
 —fractures, lower end, 502
 —middle third, 502
 —shaft, 501
 —tubercle, 501
 —upper end, 501
 —upper epiphysis, 501
 —hypertrophy of, 386
 Tibial nerve, anterior, 374, 375
 —internal popliteal, 377
 —paralysis of, 378
 —foot muscles involved in, 378
 —gastrocnemius muscle in, 378
 —lesion in, leg, below middle of, 378
 —upper or in thigh, 377
 —muscles involved in, leg, 378
 —regional chart of, 378
 —soleus muscle in, 378
 Tibial node, syphilis and, 391
 Tinnitus aurium, head injury and, 50
 Tobacco history, forming of, 4
 —gastro-enteric tract affections and, 3
 Toes, affections of, 356, 358-360
 Tongue, affections of, 103, 104
 —abscess in, 106
 —actinomycosis, 106, 544
 —regional chart of, 103, 104
 —atrophy of, hypoglossal nerve affections and, 66
 —blastomycosis of, 106
 —congenital abnormalities of, 105
 —cysts of, parasitic, 107
 —fissure of, 105
 —foreign body in, 105
 —glossitis of, acute, 106
 —acute parenchymatous, 105
 —granulomata of, 106
 —history of, 104
 —interpretation of, 104
 —inflammatory conditions of, 105
 —injuries of, 105
 —leprosy of, 106
 —leukoplakia of, 106, 107
 —macroglossia of, 105
 —protrusion of, head injury and, 52
 —ranula of, 107
 —syphilis of, 106
 —thyroids and, accessory, 141
 —tongue-tie, 105
 —tuberculosis of, 106
 —tumors of, 107
 —ulcerations of, 106, 108
 Tonsils, operations upon, pulmonary abscess and, 182
 Tophi, in gout, 349
 Torsion, gall-bladder and, 721
 —Shipley, S. M., on, 721
 —hydrosalpinx and, 296
 —kidney pedicle and, 213, *facing* 721
 —omentum and, 611, *facing* 628
 —ovary and, cyst of, 292
 —ureter and, 217
 Torticollis, 127
 —spasmodic, spinal accessory nerve affections and, 66
 Tracheal "tug," aneurysm and, 195
 Transillumination, hydrocele and, 263
 —scrotum and, 260
 Transposition, liver, 713
 —stomach, congenital, 614
 Trapezius muscle, rupture of, 326
 Traube's semilunar space, 6, 556
 Traumatic aneurysm, 529
 Traumatic asphyxia, 148
 Traumatic rupture, gall-bladder and, 573
 Tremor, alcoholic history and, 4
 —cerebellar affections and, 79
 —dyspepsia and, 4
 —exophthalmic goiter and, 139
 —eye affections and, 4
 —laryngeal difficulties and, 4
 —nervousness and, 4
 —ophthalmoscopic examination and, 4
 —tobacco history and, 4
Treponema pallidum, affections caused by, 27, 28
 Triangle, Bryant's, Fig. 21, 493; 495
 —Petit's, perinephritic abscess and, 211
 Triceps muscle, musculospiral nerve paralysis and, 368
 —nerve supply of, 365
Trichina spiralis in muscle, 544
 Trigeminal nerve, 64
 Trigger finger, 345
 Trochlea, fractures of, 478
 Trochlear nerve, injury of, 64
 Tubal patency, tests for, 296, 297
 Tubal pregnancy, 296, 694, 695
 Tubercle, brain, solitary, 75, 79
 —tibia, Osgood-Schlatter's disease in, 392
 Tubercle bacillus, surgical affections caused by, 26
 Tuberculin test, hip tuberculosis and, 653
 Tuberculosis, abdominal wall, 580
 —acromioclavicular joint, 332
 —ankle, 430
 —appendix, 647
 —bladder, 229
 —bone, 389, 390, 435, 437
 —brain, 75
 —breast, 171
 —bursæ, 551
 —olecranon, 336
 —prepatellar, 354
 —subdeltoid, 328
 —cecal, 654
 —elbow joint, 339, 430
 —elephantiasis of leg caused by, 356
 —endometrium, 301
 —secondary to tuberculosis elsewhere, 301
 —epididymis, 262, 263, 264
 —face, 83
 —fallopian tube, 295
 —finger, 348
 —forearm, 342, 343
 —granulomatous infection of, 22
 —hip, 350, 429, 597, 652
 —humeral shaft, 337
 —ileocecal region, 636
 —jaw, 111
 —kidney, 211, 212
 —knee, 429

- Tuberculosis, large intestine, 661, 662
 — lip, 99, 100
 — liver, 717
 — lumbar region, 212
 — lungs and pleuræ, 185, 211
 — lymph gland, acute, axillary, 159
 — — cubital, 337
 — — enlargement in, 538, 541
 — — neck, 130
 — lymphatics, 535
 — — forearm, 342
 — — leg, soft parts of, 356
 — mediastinum, 194
 — mesentery, 607
 — mouth, 103
 — muscle, 544
 — ovarian, 289
 — — fallopian tube involvement in, 289
 — — peritoneal tuberculosis associated with, 289
 — — pancreatic, 698
 — parotid gland, 93
 — penis, 246, 253
 — peritoneal, 289, 603, 605, 606
 — phalangeal, 348
 — prostatic, 236
 — — kidney tuberculosis and, 211
 — pulmonary, pneumothorax as a complication of, 186
 — — surgical pneumothorax indicated in, 185
 — rectum and anus, 670
 — scalp, 49
 — scapular, 331
 — seminal vesicle, 239
 — shoulder, 329, 330, 332
 — skull, 55
 — small intestine, 636
 — splenic, 704
 — sternoclavicular joint, 331
 — stomach, 622
 — tendon, 548
 — tendon sheath, 548
 — — hand and finger, 348
 — — wrist, 344
 — testicle, 263
 — — secondary to epididymis, 263
 — thigh, muscles of, 352
 — — soft parts of, 352
 — thoracic wall, 152
 — thyroid gland, 137
 — tongue, 106
 — ureteral, 216
 — urethral, 257, 258
 — uterine, 301
 — vesicle, seminal, 239, 240
 Tuberculosis verrucosa, of face, 83
 Tuberculous form of leprosy, 23
 Tuberculous ulcer, 35, 84, 357
 Tubo-ovarian cyst, 289
 Tubo-ovarian disease, 283, 294
 Tuffier, on aneurysm of hepatic artery, 718
 Tumors, Chap. III, 37
 — abdominal wall, 581
 — — benign, 581
 — — malignant, 581
 — adenocarcinoma, 42
 — adenofibroma, 38
 — adenoma, 38
 — adenomyoma, 40
 — appendical, benign, 647
 Tumors, appendical, malignant, 650
 — axillary, benign, 162
 — — malignant, 163
 — basal ganglia, 80
 — bile-duct, 730
 — bladder, 230, 231
 — — benign, histologically, death from, 230
 — — connective tissue origin, 231
 — — epithelial origin, 230
 — — Küster's classification of, 218
 — — pyelonephritis with, 230
 — villous, 230. *See also* Papilloma.
 — bone, 384
 — — benign, 399
 — — differential chart of, 400-405
 — — giant-cell, differential chart of, 400, 401
 — — Kolodny (Codman) classification of, 404, 405
 — brain, 79
 — breast, benign, 173
 — — differential chart (clinical) of conditions causing, 176, 177
 — — injury and, 146
 — — malignant, 174
 — broad ligament, 293
 — carcinoma, 41
 — — basal-cell, 42
 — — colloid, 42
 — — scirrhus, 42
 — carotid body, 134
 — cecal, 657
 — cerebellar, 79
 — cerebral, apoplectic seizures in, 74
 — — skull fracture complicated by, 447
 — cerebral cortex, 80
 — chloroma, 42
 — chondroma, 38
 — classification of, clinical, 37
 — corpora quadrigemina, 80
 — cystadenoma, 38
 — desmoid, 581
 — duodenal, 722, 723
 — — malignant, 628 insert 1
 — encephalitis associated with, acute, 71
 — endothelioma, 42
 — epithelioma, 42
 — esophageal, 203, 204
 — face, 85, 90, 91
 — fallopian tube, 296
 — fibroma, 38
 — — durum, 38
 — — molle, 38
 — — molluscum, 39
 — — papillary, 38
 — — tuberos, 38
 — fibromyoma, 39
 — forearm, soft parts of, 342
 — gall-bladder, 720
 — — benign, 720
 — — malignant, 720
 — glioma, 39
 — jaw, 111
 — joint, 419, 436
 — keloid, 39
 — kidney, 215
 — knee joint, 436
 — large intestine, 663
 — — King on, 664
 — leg, soft parts of, 357
 — leiomyoma, 39

- Tumors, lipoma, 40
 — lipomatosis, multiple, 40
 — liver, 716
 — lung, 187, 190
 — pleuræ and, malignant, aspiration in, 191
 — lymphangioma, 40
 — lymphoma, malignant, 43
 — — typical, 40
 — — mediastinal, 198
 — — pressure on phrenic nerve in, 198
 — medullar, 80
 — mesenteric, lipoma, 608
 — — fibroma, 608
 — — myofibroma, 608
 — — sarcoma, 608
 — mixed, of face, 90
 — mouth, 103
 — muscle, 546
 — myeloma, 43
 — myofibroma, 39
 — myoma, 39. *See also* Myofibroma.
 — myxoma, 40
 — neck, 128
 — — cystic, 128
 — — mixed, 142
 — neuroglioma ganglionare, 79
 — neuroma, 40
 — omental, 611
 — — endothelioma, 611
 — — fibromyoma, primary multiple, 611
 — — lipoma, 611
 — — sarcoma, 611
 — osteoma, 41
 — — cancellous, 41
 — — ivory, 41
 — ovarian, malignant, 290
 — — solid, 290
 — — — adenoma, 290
 — — — dermoid, 290
 — — — fibroma, 290
 — — — myoma, 290
 — palpation of, facts ascertained by, 5
 — pancreatic, 699
 — — benign, 699
 — — malignant, 699
 — papilloma, 41
 — parotid gland, 93
 — — mixed cell, benign, 93
 — — — malignant, 96
 — penis, 254
 — percussion of, facts ascertained through, 6
 — peritoneal, 606
 — polyp, 39
 — pons, 80
 — prostatic, 237, 238
 — psammoma, 42
 — rectal, "ribbon" stools in, 676
 — — anal and, 674, 675, 676
 — — rhabdomyoma, 41
 — — round ligament, 294
 — — salivary gland, mixed, 44
 — — sarcoma, 43
 — — — lymphosarcoma, 44
 — — — melanotic, 44
 — — — round-cell, 44
 — — — spindle-cell, 44
 — — scapular, benign, 331
 — — small intestine, 637
 Tumors, splenic, 709
 — stomach, 722, 723
 — — benign, 622
 — — carcinoma, 628
 — — malignant, 622, 628 insert 1
 — tendon, 549
 — testicle, benign, 264
 — — malignant, 264
 — — hydrocele, differentiated from, 263
 — — mixed, 45
 — thigh, soft parts of, 352
 — thoracic wall, 153
 — tongue, 107
 — umbilical, 583
 — ureteral, 218
 — urethral, 257
 — — chronic urethritis caused by, 257
 — uterine, 299
 — — benign, 299
 — — malignant, 299
 — vaginal, 308
 — vertebral column, 417
 — von Recklinghausen's disease and, 39
 — vulval, 310
 — — benign, 310
 — — malignant, 310
 — xanthoma, 41
 Tunica vaginalis, hematocele, 262
 Tuttle, on pancreatic inflammations, 711
 Tympany, abdominal, percussion for, 6
 — ascites and, 604
 — cyst and, ovarian, 604
 — — pancreatic, 605
 — fibroid and uterine, 604
 — gastric dilatation and, acute in, 616
 — intestinal, percussion for, 7
 — intestinal obstruction and, 679
 — mass and, percussion for, 6
 — meteorism and, 605
 — pregnancy and, 605
 — Traube's semilunar space and, 556
 — tumor and, percussion for, 6
 — urinary retention and, 605
 Typhilitis, 656. *See also* Cecum, affections of.
 Typhoid bacillus, surgical affections caused by, 27
 Typhoid fever, hydrocele and, 262
 — phlegmasia alba dolens in, 352
 — surgical conditions and, 17, 28, 29
 Typhoid osteomyelitis, acute, thoracic wall, 151
 Typhoid ulcer, perforating, 634, 635
 Typhoidal arthritis, 428
 — hip joint, 350
 — shoulder joint, 332
 Ueros, R., on relation of uterine myomata and pregnancy, 299
 Ulcers, Chap. II, 31
 — actinomycotic, 35
 — chilblains followed by, 360
 — classification of, 33
 — corneal, trigeminal nerve injury and, 65
 — glanders and, 84
 — gouty, 35
 — hand, perforating, syringomyelia and, 346
 — herpetic, 35
 — history of, 32
 — lip, 98

- Ulcers, mercurial, 35
 — noma and, 82
 — perforating, 34
 — rodent. *See* Epithelioma.
 — sarcomatous, 35
 — simple, 33
 — syphilitic. *See* Penis, affections of;
 Tongue, affections of.
 — tongue, differential chart of, 108
 — trophic, 34
 — tuberculous, 35, 83
 — typhoid, 649
 — — perforating, 634
 — varicose, 34, 533
 Ulna, congenital deformities of, absence in,
 341
 — — dislocation in, 338
 — dislocations of, 516, 517
 — fractures of, 487
 — — epiphyseal separation in, 485
 — — examination in, 481, 484
 Ulnar artery, aneurysm of, 343
 Ulnar nerve, 365
 — injuries of, 335
 — paralysis of, etiology of, 371
 — — finger muscles in, 373
 — — Froment on, 372
 — — lesion in, forearm, below elbow of, 373
 — — — middle third of, 372
 — — — hand, 372
 — — — upper arm, 371
 — — muscles involved in, 373
 — — — hand, in, 373
 — — — regional chart of, 373
 — — — wrist, 373
 — — Steward and Evans on, 372
 Ulnar nerve region, anesthesia of, Klumpke's
 paralysis and, 346
 Umbilicus, Chap. XVI, 581
 — carcinoma of, 584
 — — primary, 584
 — — secondary, 584
 — concretions of, 582
 — cysts of, 583
 — erysipelas of, 582
 — fistulæ of, 583
 — gangrene of, 582
 — gumma of, 583
 — hernia of, 583, 589
 — inflammations of, 582
 — noma of, 582
 — swelling of, percussion in, 7
 — tumors of, 583, 584
 Unciform bone, fracture of, 487
 Urachus, 606
 — cysts of, 605
 — patent, 227
 Urea, blood, 741
 Ureter, affections of, regional chart of, 216
 — anomalies of, congenital, 216
 — calculus of, 217, 652
 — — cystoscopic examination in, 217
 — — hydro-ureter caused by, 217
 — — radiography in, 217
 — caruncle of, 218
 — diverticulum of, 217
 — granulomata of, 216
 — hydro-, 217
 — inflammatory conditions of, 216
 — injury of, 216, 574, 575
 Ureter, obstruction of, 217
 — palpation of, 217
 — stricture of, 217
 — — catheter in, use of, 217
 — — Church on, 217
 — — cystoscopic examination in, 217
 — — Hunner on, 217
 — — pyelography in, 217
 — — references, 273
 — torsion of, 217
 — tuberculosis of, 216
 — tumors of, 218
 — ureteritis, 216
 Ureterovaginal fistula, 307
 Urethra, affections of, 255
 — calculi of, 257
 — caruncle of, 257
 — chancre of intra-urethral, 257
 — contusions of, 255
 — "false passage" of, 255, 261
 — fistulæ of, etiology of, 258
 — foreign bodies in, 257
 — granulomata of, 257
 — injuries of, 255
 — — pelvic fractures complicated by, 492
 — penis and, affections of, history of, 246
 — rupture of, 256
 — — urine extravasation of, 256
 — stricture of, 257
 — persistent gleet causing, 247
 — tuberculosis of, 257
 — — primary, 257
 — — secondary, 257
 — tumors of, 257
 — wounds of, 255
 Urethritis, chronic, urethral tumors caused
 by, 257
 Urethropenile fistula, 258
 Urethroperineal fistula, 258
 Urethrosclerotical fistula, 258
 Urinary symptoms, bladder and prostate and
 seminal vesicle affections and, 223
 Urinary tract, injury of, abdominal wall
 injury and, 574
 Urination, abdominal injury and, 569
 — difficulty in, 228, 237, 238, 257, 306
 — increased frequency of, 210, 212, 227, 229-
 230, 235-238, 258, 264, 306
 — genito-urinary tract affections and, 3
 — pain on, 210, 236, 257, 309
 Urine, appendicitis and, acute, 650
 — Banti's disease and, 710
 — biliary tract and, affections of, *facing* 721,
 728
 — bladder and, affections of, 228, 229, 230,
 231
 — blood in, 265. *See also* Hematuria.
 — Cammidge reaction in, 700
 — *Eustrongylus gigas* disease and, 215
 — examination of, 7, 8
 — extravasation of, 256, 261, 262
 — inoculation with, guinea-pig, tuberculosis
 of kidney and, 212
 — jaundice and, 733
 — kidney affections and, 208, 212, 213, 215
 — pancreas and, affections of, 695, 699, 700
 — prostate and, affections of, 236, 237
 — pyelitis and, 211, 648
 — retention of, 226, 235, 237, 256, 298, 306,
 605

- Urine, ureteral stricture and, 217
 — urethral tuberculosis and, 258
 Uterosacral ligament, adenomyoma of, 292
 Uterus, affections of, 297
 — carcinoma of, 299
 — — bimanual examination in, 300
 — — death from, 300
 — — cervix of, atresia of, 305
 — — carcinoma of, 300
 — — chancre of, 305
 — — hypertrophy of, 304
 — — inflammation of, 302
 — — laceration of, 303
 — — mucosa eversion of, 305
 — — polypi of, 304
 — — stenosis of, 305
 — — chorio-epithelioma of, 299
 — — metastasis of, to liver, 301
 — — lungs, 301
 — — pregnancy with, 301
 — — prognosis in, 301
 — — symptoms of, 301
 — — displacements of, 298
 — — fibroid of, abdominal enlargement caused by, differential chart of, 604
 — — hematometra of, 302
 — — hernia of, 303
 — — inflammations of, 301
 — — injuries of, 297, 298
 — — inversion of, 298, 299
 — — leiomyoma of, developing into sarcoma, 300
 — — malformations of, absence, 297
 — — — bicornis, 297
 — — — bilobularis, 297
 — — — didelphys, 297
 — — — effect on sterility of, 297
 — — — fetal or infantile form, 297
 — — — intra-uterine septum, 297
 — — — one-horned, 297
 — — — rudimentary body, 297
 — — perforation of, abortions causing, 298
 — — — bougies or curets causing, 298
 — — retroflexion of, 298
 — — subinvolution of, 302
 — — — bimanual examination in, 303
 — — — chronic, symptoms of, 303
 — — — superinvolution of, 303
 — — — sterility in, 303
 — — tumors of, 299
 — — sarcoma of, ovarian extension causing, 300
 — — — preëxisting leiomyoma developing into, 300
 — — wounds of, 297
 Vagina, affections of, 305
 — — bleeding of, tubal pregnancy and, 296
 — — carcinoma of, 309
 — — cystocele of, 306
 — — cysts of, 308
 — — discharge from, venereal history and, 4, 301
 — — fistula of, 307
 — — hematocolpos of, 309
 — — hernia of, 307, 592
 — — inflammations of, 307, 308
 — — injuries of, 306
 — — malformations of, 305
 — — rectocele of, 307
 Vagina, sore on, venereal history and, 4
 — — sinus of, 227
 — — stenosis of, 305
 — — tumors of, 308, 309
 Vaginismus, 312
 Vaginitis, 307, 308
 Vagino-rectal fistula, malformations of vagina and, 305
 Vagus nerve, injury of, 66
 Van den Bergh test, 729, 741
 Varicocele, parovarian, 293
 — — spermatic cord, 263
 Varicose aneurysm, 529
 Varicose ulcer, 34, 533
 Varicose veins, 533
 Varix, aneurysmal, 529
 — — bladder, 228
 — — esophageal, 203
 — — — abdominal examination in, 627
 — — — cirrhosis of liver and, 203
 — — — history of, previous, 625
 — — — jaundice in, 629
 Vascular cerebral spasm, 73
 Vasomotor disturbance, median nerve paralysis and, 370
 — — peripheral nerve injury and, 362
 — — peroneal nerve paralysis and, 379
 — — ulnar nerve paralysis and, 372
 Vasomotor spasm, leg, Raynaud's symmetric gangrene and, 356
 Vater's ampulla, 727, 728, 732, 734
 Veins, affections of, Chap. XIII, 532
 — — dilatation of, thoracic wall, mediastinal affections and, 193
 — — embolism of, 532
 — — enlarged, over breast tumors, 168
 — — — thoracic wall, retrosternal goiter and, 137
 — — hemorrhoidal, 671
 — — inflammatory conditions of, 532
 — — — phlebitis, 532
 — — — thrombophlebitis, 532
 — — injury to, 532
 — — — "milk-leg," 533
 — — phlegmasia alba dolens and, 533
 — — Retzius', 717
 — — thrombosis of, 532
 — — varicose, 533
 — — — femoral region swelling caused by, 597
 — — — vulval, 311
 Venereal history, forming of, 4
 — — kidney affections and, 208
 Venereal infections, 20
 Venery, excessive, simple vaginitis caused by, 308
 Venous sinuses, injury of, 63
 — — thrombosis of, 74
 Ventral hernia, 590
 Ventricles, affections of, regional chart of, 68
 Vermiform appendix, 640
 Verruca, 41
 — — tuberculous, of face, 83
 — — vulval, 310
 — — See also Papilloma.
 Vertebræ, cervical, dislocations of, 507
 — — dorsal, dislocations of, 508
 — — fractures of, 459
 — — — complications of, 457
 — — — diagnostic summary of, 457
 — — — etiology of, 453

- Vertebrae, fractures of, frequency of, site of, 453
 ——— mechanism of displacement in, 453
 ——— radiography in, 457
 ——— reflexes, cutaneous, 459
 ——— tendon, 459
 ——— relation to body segments, 458
 ——— sites of, coccyx, 457
 ——— dorsal, 456
 ——— lumbar, 456
 ——— sacral, 457
 ——— spinal cord, involvement in, 458
 ——— symptomatology of, 454
 — lumbar, dislocations of, 508
 — percussion of, 7
 Vertebral artery, aneurysm of, 127
 — injury of, 62
 Vertebral column, affections of, Chap. XI, 406
 — congenital anomalies of, 409
 — curvatures of, 406, 413-416
 — epiphysitis of, acute, 409
 — examination of, 407-409
 — Mannkopf's sign in, 408
 — granulomata of, 406
 — inflammations of, 406, 409, 410, 413
 — kyphosis of, 415, 416
 — Pott's disease of, 410, 412
 — scoliosis of, 414
 — spondylolisthesis of, 416
 — syphilis of, 413
 — syringomyelia of, 416
 — tuberculosis of, 410-412
 — tumors of, 417
 — typhoid spine of, 413
 Vertebral epiphysitis, 392
 Vertebral erosion, aneurysm of renal artery and, 213
 Vertigo, alcoholic history and, 4
 — auditory nerve injury and, 66
 — brain abscess and, 71
 — brain tumor and, 80
 — cerebellar lesions and, 79
 — inferior poliоencephalitis and, 71
 Vesical. *See* Bladder.
 Vesical calculus. *See* Calculi, bladder.
 Vesical fistulae, 226
 — patent urachus and, 227
 — tuberculous vesiculitis complicated by, 240
 — vesico-abdominal, 227
 — vesicoperineal, 227
 — vesicovaginal, 226
 Vesicles, seminal, infections of, 238
 Vesico-abdominal fistula, 227
 Vesicoperineal fistula, 227
 Vesicovaginal fistula, 226, 307
 Vesiculitis, acute, 238
 — symptoms of, 238
 — chronic, 238
 — tuberculous, perineal fistula complicating, 240
 — rectal fistula complicating, 240
 — vesical fistula complicating, 240
 Vibration sense, peripheral nerve injury and, 362
 Villi, chorionic, tumors from, 301
 Villous arthritis, 432
 — knee joint, 353
 Vincent's angina, 102
 — acute pharyngitis and, similarity between, 121
 Viscera, transposition of, heart in, 178
 Visible peristalsis. *See* Peristalsis.
 Vision, disturbances of, wry-neck and, 127
 — double, abducens nerve injury with, 65
 Vision center, brain, 77
 Vitello-intestinal duct, cyst of, 587
 Volkmann, ischemic contracture of, 346
 — myositis fibrosa as a sequel of, 346
 — ischemic paralysis of, fractures of humerus and, 478
 Volvulus of large intestine, 663
 Vomiting, blood, 624-625. *See also* Hematemesis.
 — brain abscess and, 71
 — brain tumor and, 80
 — cardiospasm and, 614
 — esophagus and, affections of, 200, 202, 203
 — gall-bladder and, affections of, 719-721
 — gastro-enteric tract affections and, 3
 — head injury and, 51
 — history of, abdominal conditions and, 558
 — abdominal injury and, 569
 — hydrocephalus and, 70
 — hydronephrosis and, 214
 — ileus and, paralytic, 678
 — intestinal obstruction and, acute, 678
 — intussusception and, 683
 — jaundice and, 734
 — pancreas and, affections of, 690, 693, 698, 699
 — pregnancy and, extra-uterine, 653
 — projectile, pyloric stenosis and, congenital, 614
 — stomach and, affections of, 615, 619, 622, 623, 630
 — tobacco history in, 4
 — tumors and, small intestine, 637
 — twisted ovarian cyst and, 292
 — volvulus and, 683
 Von Graefe's sign, exophthalmic goiter and, 140
 Von Jaksch's anemia, 707
 Von Mikulicz's disease, cervical lymph glands in, 133
 — face in, 84
 — lacrimal glands in, 84, 133
 — parotid gland in, 84, 133
 — sublingual glands in, 133
 — submaxillary glands in, 84, 133
 Von Pirquet reaction, peritonitis and, tuberculous, 606
 Von Recklinghausen's disease, 39
 — ossifying carcinosis, prostatic carcinoma and, 238
 — osteitis fibrosa cystica, 398
 Vulva, affections of, 309
 — chancre of, 310
 — cysts of, 310, 311
 — elephantiasis of, 311
 — hydrocele of labium majus, 311
 — inflammations of, 310
 — injuries of, 309
 — kraurosis of, 311
 — malformation of, 309
 — pruritus of, 311
 — syphilis of, 310
 — tumors of, 310
 — varicose veins of, 311
 — verruca of, 310
 Vulvitis, 310

- Wandering spleen, 704
 Warts, 41
 — hand and fingers, 347
 — penis, 254
 — *See also* Papilloma.
 Wassermann reaction, 21, 740
 Weak foot, 358
 Web fingers, 345
 Web toes, 358
 Weight, loss of, thoracic duct injury and, 196
 Weil's disease, 28
 — occupation in, 11
 Welch's bacillus, infection from, 19
 Wen. *See* Cyst, sebaceous.
 Wharton's duct, location of, 92
 White, C. S., on liver injury, 713
 Whitlow, 348. *See also* Finger nail.
 Widal reaction, 740
 Williams and Martin, on dysentery, 661
 Willis, circle of, aneurysm of, 73
 "Winged scapula," rupture of trapezius muscle and, 326
 Winslow, foramen of, hernia through, 593
 Wolffian body, cyst of, papillary, 291
 Woolsorter's disease, 16
 Wounds, abdominal wall, 571
 — arterial, 527
 — bladder, 227
 — bone, 385
 — esophageal, 200
 — heart, shock in, 178
 — — with hemopericardium, 178
 — joint, penetrating, 423
 — of lung, 145. *See also* Thoracic wall wounds.
 Wounds, lymphatic, 534
 — muscle, 542
 — ovarian, 286
 — penetrating, of pericardium, 178
 — penis, 248
 — scalp, 47
 — skin and subcutaneous tissues of upper arm, 333
 — tendon, 547
 — thoracic wall, 145
 — ureteral, 216
 — urethral, 255
 — uterine, 297
 — vaginal, 306
 — vein, 532
 Wrist joint, affections of, 343
 — contracture of, 344
 — dislocations of, 518
 — fractures of, 485
 — injuries of, 343
 — Klumpke's paralysis in, 346
 — Madelung's spontaneous subluxation of, 345, 424
 — malformations of, congenital, 343
 — tendon sheaths of, affections of, 344
 Wrist drop, 334, 367, 368
 Wry-neck, 127. *See also* Torticollis.

 Xanthoma, 41
 — face, 90.
 — tendon, 549

 Zygomia, fracture of, 447

